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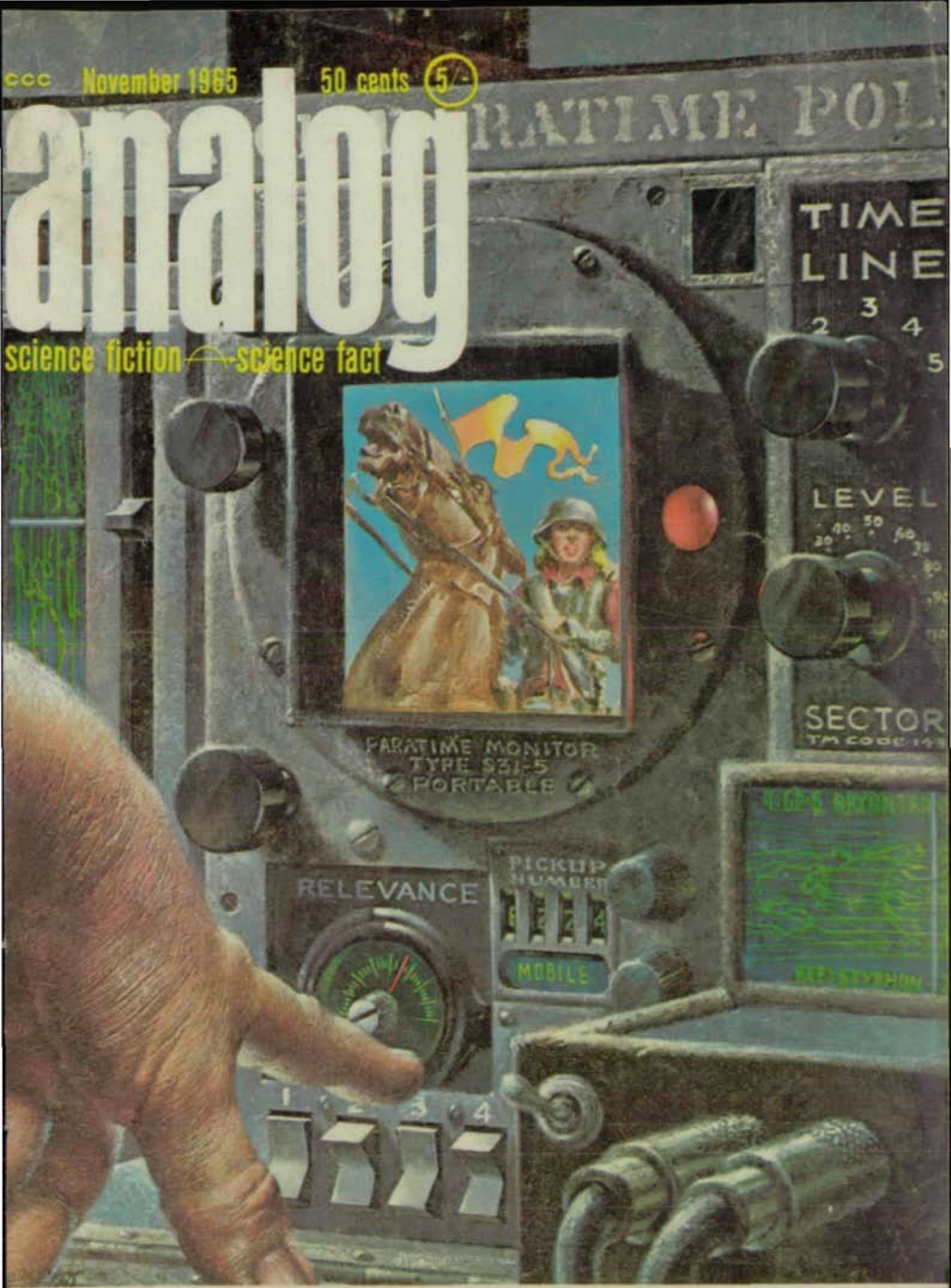

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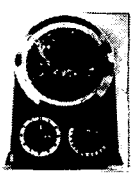

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COLLOID and CRYSTALLOID

EDITORIAL BY JOHN W. CAMPBELL

Several science-fiction areas have been ruined, recently, by the advance of factual knowledge. Venus as a lush, jungle planet full of strange animals and beautiful practically human maidens, for instance, went out when Mariner II reported back. Any Venusian maidens could do soldering by just squeezing the stuff between their superheated fingers.

Mariner IV has done almost an equally good job of rebuilding our picture of Mars; that 1%-of-Earth's atmosphere, with winds so vicious they can whip dustclouds a hundred kilometers into the thin air—not, I'm afraid, where John Carter of Mars lived.

But an even more devastating blow is being dealt to robots in a less spectacular, more leisurely fashion. Turns out they ain't what they're cracked up to be.

Let's explain it in a little story, about a young, muscular, and wise Engineer, who has invaded the private sanctum of an Evil Mad Scientist. The Scientist has been building robots with which he plans to Conquer the World.

The Engineer is detected, and the Mad Scientist chortles "Heh! Run—go ahead! Much good it will do you! My mighty robots will tear you to pieces as they will destroy all my enemies!" He then looses a horde of various robots after the fleeing Engineer, robots ranging from 100-ton self-directed super-tanks-with-grabbing-attachments, down to small sizes for spy work.

The Engineer gains a few moments by climbing up and over the perimeter fence—while the robots obey their program and go through the gate—and racing down toward the marshy ground leading to the narrow estuary on which the Mad Scientist had built his place. He plunges into the water, swims as fast as he can the two hundred yards to the opposite side, climbs out, and races toward a rocky cliff a quarter-mile away.

He has to stop and swat down a few flying spy robots that are following, being very annoying like over-size mosquitoes, but essentially harmless. He's also slowed down by having to work his way in, through, among, and over the boulders that have fallen from the weathering of the cliff.

However, all the fast, wheeled robots are being dragged out of the marsh by slow, tracked service robots by this time. The 100-ton super-tanks made it through the marsh O.K., but they're lighting all the trouble lights on the Mad Scientist's monitor boards; they were proof against shells, and poison gases wouldn't bother their machinery—but the Mad Scientist hadn't

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provided insulation adequate to stop salt water under pressure. There are three of them stuck at the bottom of the estuary. Since the bottom's pretty muddy, they're gradually sinking deeper into the mud. Some amphibian models made it through the marsh on their tracks, by going into low-low and churning, made fair time through the estuary, but are now stuck with churning tracks between some of those fallen boulders.

Four quasi-manlike robots managed to get across the estuary—they walked across the bottom, with enormous expenditure of power because of the soft mud and they're far heavier than water—and are doing quite well getting through the boulders.

The Engineer, however, has reached the cliff, and is working his way up a chimney. Fortunately the Mad Scientist has run out of flying spy-types; they were most pestiferous.

Wet, hot, panting heavily, the Engineer finally reaches the top of the cliff and sits down to rest.

One of the humanoid robots emerges from the chimney, and starts toward him. The Engineer stands up, grasps the robot's arms, and twists them into a square knot, knocks the machine down, plants a foot on it, and yanks off first the left and then the right leg.

Finally he sits down comfortably, props the robot's head in front of him, and says, "Now, you old fool, will you be a little more sensible? I know you're listening to the pickups in this contraption. Sure, metal machines are stronger than living organisms—when you have five tons of metal, and one hundred fifty pounds of organism, power the thing with a power house, and ask it to do only one thing, or a very few things.

"But this cute little multipurpose gadget—and I'll give you full credit on it; I didn't think you could make one that could follow me up a rock chimney!—had to be built so lightly, so delicately, that its arms and legs are far weaker than mine. Yet it weighs about two hundred seventy pounds to my two hundred and ten."

This, of course, was a very short chase; it didn't require the robot to continue functioning without power input for two weeks, and then require that it live off the country. It didn't have to build repair parts for itself and install them properly, either. It wasn't really a fair test of Man vs. Machine.

The Myth of the Mighty Robot stems from a basically false conception; the idea that metal is stronger by far than flesh and bone. The simple fact is—bone is stronger than the best steels available! Not only in terms of strength per pound, but even in terms of strength per cubic inch.

A prosthetics engineer, some years back, told me of the trouble

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they had making a surgical prosthesis to replace accident-destroyed hip joints. The problem was to make a gadget that could replace the top portion of the human thigh bone, the femur. As an engineering problem it's a dilly, because the femur has an offset that carries the loads around a 45° angle—which is something no engineer likes having to do. It's necessary, however, to allow room between the thighs for the powerful muscle-engines needed to operate the complex leg functions.

They built a machine that walked like a man, and built in strain gauges to measure the forces imposed by normal walking activity. The results didn't make them happy; they found forces as high as seventy-two hundred pounds in a one hundred fifty pound man's normal daily movements.

The neck of the femur—the part that goes from the end of the straight member to the ball that fits in the socket of the hip—is approximately ⅝ inch in diameter. When they built a stainless steel member of dimensions to fit in the place of the original bone, it snapped under the loads.

They did quite a bit of design and testing of alloys before they got one that would fit in the available space, and could carry the loads. It was not—not by a long shot!—as light as the bone it replaced. It was, however, reasonably successful as a surgical prosthesis.

Last I heard about it, they'd had a few snap in service. One failed when the Navy veteran who'd lost his original in a kamikaze attack, slid into first base in a softball game.

The engineer was still working on another problem; a unit to replace the left elbow joint. (In England, where they drive on the left, they need replacement right elbow joints.) This project had been stalled for some time because of a small bony finger in the human elbow, which serves as a stop to prevent the elbow swinging beyond the straight-out position. The dimensions of the little bony piece are determined by the placement of other components of the joint; you can't make it twice as thick, or increase its length—you're stuck with the original dimensions. When a baseball pitcher suffers from a sore arm, it's usually that little bony finger that's in trouble.

The engineers were in trouble because no stainless steel or other noncorrosive alloy that the body fluids would tolerate could take the terrific shock loads that are imposed on that little piece of bone. It simply got mashed out of shape, or broke off when they tried their metal duplicates.

This was, as I say, several years ago. At the time, I repeated that data to another engineer friend, who flatly and absolutely refused to believe it. It was impossible nonsense; stainless steels are far strong-

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er than any piece of rock—and certainly stronger than a piece of porous calcium phosphate such as bone!

It's precisely that thinking that's led to the conviction that metal robots would, of course, be far stronger than living organisms.

The explanation didn't appear until quite recently—when engineers themselves produced a material that had a working strength an order of magnitude greater than they could account for! The epoxy-fiberglass panels used in printed circuit-mounting boards today, where high strength and rigidity at low weight are vital, as in space vehicles, have fantastic properties. The stuff is lighter than aluminum, has a tensile strength and a rigidity greater than steel, and, just incidentally, a corrosion resistance that puts both metals to shame. The elasticity of the stuff is such that it can be bent into a 180° curve, and, when released, snaps back—*not* like a steel spring, but with far better recovery.

Its properties so exceeded any expectations that the stuff demanded a new basic-research program to find out how it could possibly do what it quite obviously did.

That led them to the concept of "two-phase materials." In the epoxy-fiberglass, the two phases are the glass fibers, and the epoxy glue that binds them together. The generalized approach is a hard phase, and a softer binding phase that holds the harder crystalline phase locked together. Perfect glass fibers have been produced in the laboratory that show strengths in the order of 2,000,000 pounds per square inch—some ten times the strength of high-strength steel. However, the slightest crystalline defect—and the strength plummets, because under stress, the defect spreads, acting as a wedge to cleave sound crystalline material. The 2,000,000 pound strength could never be realized in glass because of that spreading of defects.

When minute fibers are bound together with a glue, however, the defect can spread only through the one fiber—while the stress is carried across to adjoining fibers, which are not defective *at that point,* and can readily carry the load. Break a link in a chain, and the chain breaks; break a fiber in a rope, and the rope is essentially unchanged. So with the two-phase materials; like ropes, the stress is distributed, and they don't fail.

Once this was recognized, some further research turned up some highly interesting things. Measuring individual crystal strengths, they found that iron is one of the weaker metals; the strongest of all metals, by far, is, very unfortunately, iridium. It's unfortunate, because it's also the densest element and sells for about five times the price of platinum. But the second strongest,

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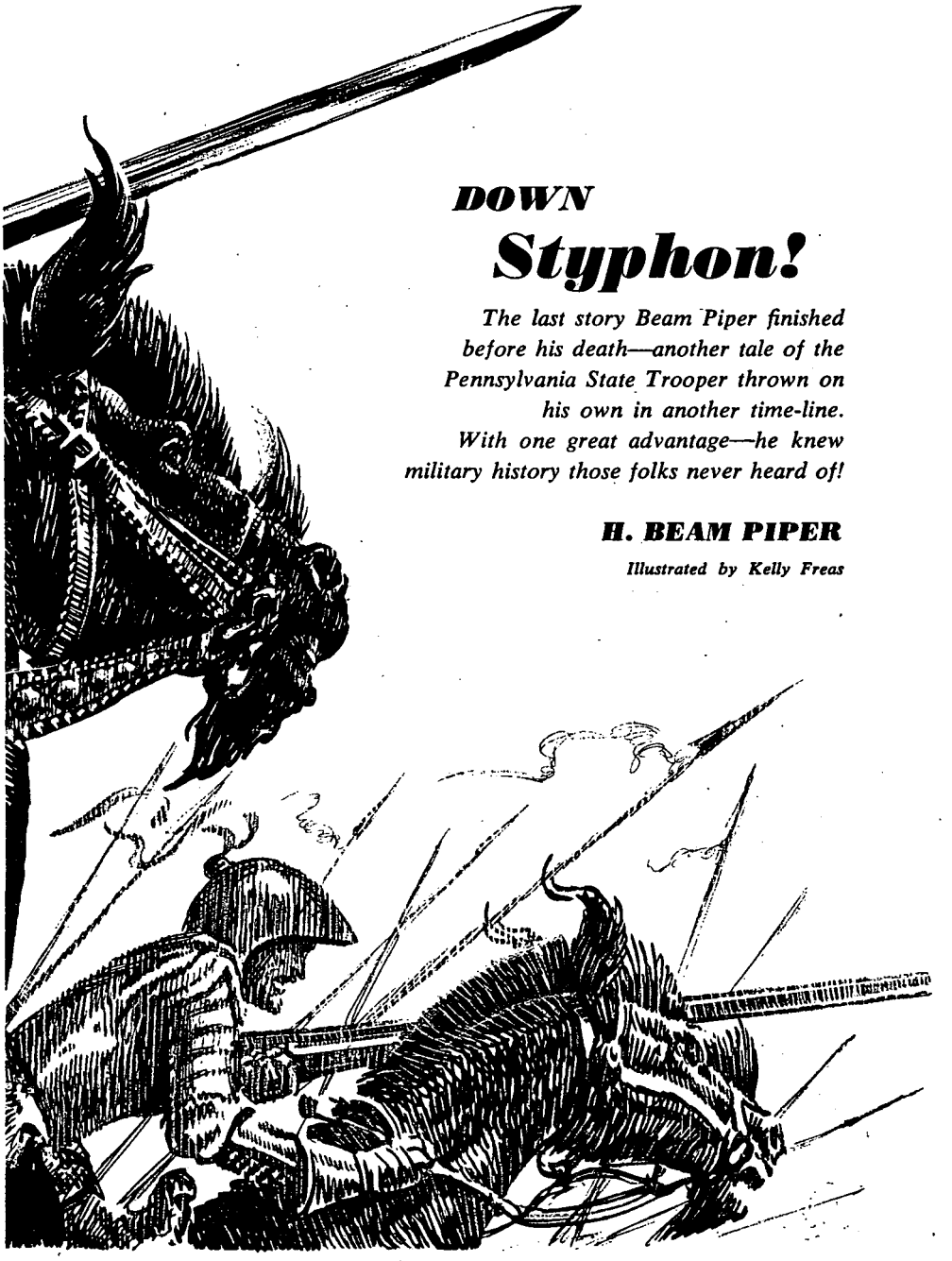

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H. BEAM PIPER

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In the quiet of the Innermost Circle, in Styphon's House Upon Earth, the great image looked down, and Sesklos, Supreme Priest and Styphon's Voice, returned the carven stare as stonily. Sesklos did not believe in Styphon, or in any other god; if he had, he would not be sitting here. The policies of Styphon's House were too important to entrust to believers. The image, he knew, was of a man—the old high priest who, by discovering the application of a half-forgotten secret, had taken the cult of a minor healer-god out of its mean back-street temples and made it the power that ruled the rulers of all the Five Great Kingdoms. If it had been in Sesklos to worship anything, he would have worshiped that man's memory.

And now, the first Supreme Priest looked down upon the last one. He lowered his eyes, flattened the parchment on the table in front of him, and read again:

PTOSPHES, *Prince of Hostigos, to* SESKLOS, *calling himself Styphon's Voice, these*:

False priest of a false god, impudent swindler, liar and cheat!

Know that we in Hostigos, by simple mechanic arts, now make for ourselves that fireseed which you pretend to be the miracle of your fraudulent god, and that we propose to teach these arts to all, that hereafter Kings and Princes minded to make war may do so for their own defense and advancement, and not to the enrichment of Styphon's House of Iniquities.

In proof thereof, we send you fireseed of our own make, enough for twenty musket charges, and set forth how it is made, thus:

To three parts of refined saltpeter add three fifths of one part of charcoal and two fifths of one part of sulfur, all ground to the fineness of bolted wheat flour. Mix these thoroughly, moisten the mixture and work it to a heavy dough, then press the dough to cakes and dry them, and when they are dry, grind and sieve them.

And know that we hold you and all in Styphon's House of Iniquities to be our mortal enemies, and the enemies-general of all men, to be dealt with as Wolves are, and that we will not rest content until Styphon's House of Iniquities is utterly cast down and ruined.

PTOSPHES

That had been the secret of the power of Styphon's House. No ruler, Great King or petty lord, could withstand his enemies if they had fireseed and he had none. Given here, armies marched to victory; withheld there, terms of peace were accepted. In every council of state, Styphon's House had spoken the deciding word. Wealth had poured in, to be lent out at usury and return more wealth.

And now, the contemptible prince of a realm a man could

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ride across without tiring his horse was bringing it down, and Styphon's House had provoked him to it. There were sulfur springs in Hostigos, and of Styphon's Trinity, sulfur was hardest to get. When the land around the springs had been demanded of him, Ptosphes had refused, and since none could be permitted to defy Styphon's House, his enemy, Prince Gormoth of Nostor, had been raised against him, with subsidies to hire mercenaries and gifts of fireseed. When Gormoth had conquered Hostigos, he was pledged to give the sulfur springs to Styphon's House. Things like that were done all the time.

But now, Ptosphes was writing thus, to Styphon's Voice Himself. For a moment, the impiety of it shocked Sesklos. Then he pushed aside Ptosphes' letter and looked again at the one from Vyblos, the high priest of the temple at Nostor Town. Three moons ago, a stranger calling himself Kalvan and claiming to be an exiled prince from a far country—the boast of every needy adventurer—had appeared in Hostigos. A moon later, Ptosphes had made this Kalvan commander of his soldiers, and had set guards on all the ways out of Hostigos, allowing any to enter but none to leave. He had been informed of that at the time, but had thought nothing of it.

Then, six days ago, the Hostigi had captured Tarr-Dombra, the castle guarding Gormoth's easiest way into Hostigos. The castellan, a Count Pheblon, cousin to Gormoth, had been released on ransom-oath, with a letter to Gormoth in which Ptosphes had offered peace and friendship and the teaching of fireseed making. A priest of Styphon, a black-robe believer, who had been at the castle, had also been released, to bear Ptosphes' letter of defiance to him.

It had, of course, been the stranger, Kalvan, who had taught Ptosphes' people the fireseed secret. He wondered briefly if he could be a renegade from Styphon's House. No; only yellow-robe priests of the Inner Circle knew the full secret as Ptosphes had written it, and had one of these absconded, the news would have reached him as swiftly as galloping relays of horses could bring it. Some Inner Circle priest could have written it down, a thing utterly forbidden, and the writing fallen into unconsecrated hands, but he questioned that. The proportions were different, more saltpeter and less charcoal. He would have Ptosphes' sample tried; it might be better than their own.

A man, then, who had re-discovered the secret? That could be, though it had taken many years and many experiments to perfect the processes, especially the caking and grinding. He shrugged. That was not important; the important thing was that the secrecy was broken. Soon anyone could make fireseed, and

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then Styphon's House would be only a name, and a name of mockery.

Perhaps, though, he could postpone the end for as long as mattered. He was near his ninetieth year; soon he would die, and for each man, when he dies, the world ends.

Letters of urgency to the Archpriests of the five Great Temples, telling them all. A story to be circulated among the secular rulers that fireseed, stolen by bandits, was being smuggled and sold. Prompt investigation of all stories of anyone collecting sulfur or saltpeter or building or altering grinding mills. Immediate death by assassination for anyone suspected of knowing the secret.

And, of course, destruction of Hostigos; none in it to be spared, even for slavery. Gormoth had been waiting until his crops were harvested; he must be made to strike now. And as Archpriest of Styphon's House Upon Earth to Nostor, this was quite beyond poor Vyblos' capacities, with more silver, and fireseed and arms, for Gormoth.

He glanced again at Vyblos' letter. A copy of Ptosphes' letter to him had been sent to Gormoth; why, then, Gormoth knew the fireseed secret himself! It had been daring, and fiendishly clever, of Ptosphes to give this deadly gift to his enemy.

And with the archpriest, fifty mounted Guardsmen of the Temple, their captain to be an Inner Circle priest without robe, and more silver to corrupt Gormoth's nobles and his mercenary captains.

And a special letter to the high priest of the temple at Sask Town, It had been planned to use Prince Sarrask of Sask as a counterpoise to Gormoth, when Gormoth had grown too mighty by the conquest of Hostigos. The time for that was now. Gormoth was needed to destroy Hostigos; then he, too, must be destroyed, before he began making fireseed in Nostor.

He struck the gong thrice, and as he did he thought again of the mysterious Kalvan. That was nothing to shrug off; it was important to learn whence he had come before he appeared—he was intrigued by Vyblos' choice of that word—in Hostigos, and with whom he had been in contact. He could have come from some distant country, in which fireseed was commonly made by all. He knew of none such, but it could well be that the world was larger than he thought.

Or could there be other worlds? The idea had occurred to him, now and then, as an idle speculation.

It was one of those small late-afternoon gatherings, with nobody seeming to have a care in the world, lounging indolently, smoking, sipping tall drinks, nibbling canapes, talking and laughing. Verkan Vall, who would be Chief of Paratime Police after Year-End Day, flicked

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his lighter and held it for his wife, Hadron Dalla, then applied it to his own cigarette. Across the low table, Tortha Karf, the retiring chief, was mixing another drink, with the concentrated care of an alchemist compounding the Elixir of Life. The Dhergabar University people—the elderly gentleman who was head of the department of Paratemporal Theory, the lady who was professor of Outtime History (IV), and the young man who was director of outtime study operations—were all smiling like three pussycats at a puddle of spilled milk.

"You'll have it all to yourselves," he told them. "The Paratime Commission has declared that time-line a study area, and it's absolutely quarantined to everybody but University personnel and accredited students. And five adjoining, near-identical, time-lines for comparison study. And I will make it my personal business to see that the quarantine is rigidly enforced."

Tortha Karf looked up. "After I retire, I'll have a seat on the Commission, myself," he said. "I'll make it my business to see that the quarantine isn't revoked or diluted."

"I wish we could account for those four hours after he was caught in the transposition field and before he came to that peasant's farm," the paratemporal theorist fretted. "We have no idea what he was doing."

"Wandering in the woods, trying to orient himself," Dalla said. "I'd say, sitting and thinking, for a couple of hours, trying to figure out what happened to him. A paratemporal shift like that is a pretty shattering experience for an outtimer. I don't think he was changing history all by himself, if that's what you're worrying about."

"You can't say that," the paratemporal theorist reproved. "He might have killed a rattlesnake which would otherwise have fatally bitten a child who would otherwise have grown up to be an important personage. That sounds farfetched and trivial, but paratemporal alternate probability is built on such trifles. Who knows what started the Aryan migration eastward instead of westward on that sector? Some chief's hangover, some tribal wizard's nightmare."

"Well, that's why you're getting those five control-study time-lines," the operations director said. "And that reminds me; our people stay out of Hostigos on all of them for a while. We don't want them massacred along with the resident population by Gormoth's gang, or forced to use First Level weapons in self-defense."

"What bothers me," the lady professor said over the rim of her glass, "is Vall's beard."

"It bothers me, too," Dalla said, "but I'm getting used to it."

"He grew it when he went out to that time-line, and he hasn't shaved it off since. It begins to look like a permanent fixture. And Dalla's a

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blonde, now; blondes are less conspicuous on Aryan-Transpacific. They're both going to be on and off that time-line all the time, now."

"Well, your exclusive rights don't exclude the Paratime Police. I told you I was going to give that time-line my personal attention."

"Well, you'll not introduce a lot of probability contamination, will you?" the paratemporal theorist asked anxiously. "We want to observe the effect of this man's appearance on that time-line—"

"No, of course not. But I'm already established with these people. I am Verkan, a free-trader from Grefftscharr, that's the kingdom around the Great Lakes. I am now supposed to be traveling on horseback to Zygros, about where Quebec is on Europo-American; I have promised Lord Kalvan to recruit brass-founders to teach the Hostigi how to cast brass cannon. He needs light field-pieces badly."

"Don't they have cannon of their own?" the historian asked. "I thought you said—"

"Wrought iron, welded up and strengthened with shrunk-on rings. They have iron works, there's a lot of bog iron mined in that section, but no brass foundries. There are some at Zygros, they get their copper and tin by water from the west." He turned to the operations director. "I won't be able to get back, plausibly, for another thirty days. Can you have your first study team ready by then? They'll be the Zygrosi brass founders."

The young man nodded. "They have everything now but local foundry techniques and correct Zygrosi accent. They'll need practice, you can't get manual dexterity by hypno-mech. Yes, thirty days'll be plenty."

"Good. We have two Paratime Police agents in Hostigos now, a supposed blind minstrel and a supposed half-witted boy. As soon as I show up with your crowd, they can take off their coats and go to work, and they won't even have to hunt for coathooks. And I'll set up a trading depot to mask your conveyor-head. After that, you'll be in business."

"But you're helping him win," the paratemporal theorist objected. "That's probability contamination."

"No, it isn't. If I didn't bring in fake Zygrosi brass founders, he'd send somebody else to get real ones. I will give him information, too, just what any other wandering pack trader would. I may even go into battle with him, as I did at Tarr-Dombra, with a local flintlock. But I want *him* to win. I admire the man too much to hand him an unearned victory."

"He sounds like quite a man," the lady historian said. "I'd like to meet him, myself."

"Better not, Eldra," Dalla warned. "This princess of his is handy with a pistol."

"Yes. The man's a genius. Only a

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police corporal on his own timeline, which shows how outtimers let genius go to waste. We investigated his previous history. Only son of a clergyman; father named him for a religious leader, and wanted him to be a clergyman, too. As a boy, he resisted, passively; scamped all his studies at college except history, and particularly military history, in which he was much interested. Then they had this war in Korea, you know what that was, and it offered him an escape from the career he was being forced into. Father died while he was at war, mother a year later. After the war he entered the Pennsylvania State Police. Excellent record, as far as his opportunities went; held down by routine because nobody recognized him for what he was. Then he blundered into the field of that conveyor, just when it went weak, and—"

Three months ago—no, just "at another time," he was sure of that—he had been Corporal Calvin Morrison, Pennsylvania State Police. Now he was the Lord Kalvan, in command of the army of Prince Ptosphes of Hostigos, and soon he would marry Ptosphes' daughter Rylla and become heir-matrimonial to the princely throne. That couldn't have happened in his own world.

Hostigos, of course, was no vast realm. It was only as big as Centre and Union Counties, Pennsylvania, with snips of Clinton and Lycoming. That was precisely what it was, too, except that here-and-now there was no Commonwealth of Pennsylvania, it was part of the Great Kingdom of Hos-Harphax—*Hos-* meant great—ruled by a King Kaiphranos. No, just reigned over lightly; outside his own capital at the mouth of the Susquehanna, Kaiphranos' authority was nonexistent, the present situation for example.

When he was was less evident. Going to arrest a perfectly routine hillybilly murderer, he had entered what could only have been a time-machine; emerging from it, he had landed on what could only have been another time-dimension. He had theorized a little about that, and his theories had demolished themselves half constructed. Then he had given it up and dismissed the whole subject. He had other things to think about.

Rylla, for one; it was hard not to think about her all the time. And commanding an army, once he got it made into one. And manufacturing gunpowder in competition with Styphon's House. And fighting a war, against uncomfortably steep odds. And, at the moment, a meeting of the General Staff, all of whom were new at it. So, for that matter, was he, but he had a few vague ideas of military staff organization which put him several up on any of the others. And he was hot and sweat-sticky, because he was wearing close to thirty pounds of armor, to accustom himself to the weight.

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They all stood around the big table, looking at the relief map of Hostigos and surroundings which covered the entire top. Just to show you, none of this crowd had ever realized that maps were weapons of war. Maps, here-and-now, were illuminated parchment scrolls, highly artistic and wildly inaccurate. This one had taken over a month, he and Rylla doing most of the work, from what he remembered of the U.S. Geological Survey maps he'd used on the State Police, from hundreds of talks with peasants, soldiers, woodsmen and landlords, and from a good deal of personal horseback reconnaissance.

"The bakeries in Nostor work night and day." That was old Xentos, the blue-robed priest of Dralm, who was also Prince Ptosphes' chancellor and because of contacts with his co-religionists in Nostor, head of espionage and fifth-column operations. "And milk cannot be bought at any price, it is all being made into cheese, and most of the meat is being ground for smoked sausages."

Field rations, stuff a soldier could carry in his haversack and eat uncooked. That could be stored, but Xentos also had reports of wagons and oxen being commandeered and peasants impressed as drivers. That wouldn't be done too long in advance.

"Then they'll strike soon," somebody said. "Taking Tarr-Dombra hasn't stopped Gormoth at all."

"It delayed him," Prince Ptosphes said. "He'd be pouring troops in through Sevenhills Valley now if we hadn't."

There was a smile on the thin lips, between the pointed gray mustache and the small chin-beard. Ptosphes had been learning to smile again, since the powder mill had gone into production. He hadn't, before.

Chartiphon, bulky and grizzle-bearded, stood glowering at the map. He had been chief captain of Hostigos for as long as Ptosphes had been Prince; now he was second in command—Field Marshal and Chief of Operations—and gratifyingly unresentful at Lord Kalvan being placed over him. His idea of war was to hit every head you saw, and whoever hit the most heads first won. All this staff-stuff, maps and fifth columns and logistics and intelligence and security, he did not understand, and he was happy to let somebody do it who did. He'd been informed that Lord Kalvan had been hurled into the past from a thousand years in the future by sorcery, and he probably half suspected that Lord Kalvan was a sorcerer, himself.

"Yes, but where?" he wanted to know.

Ptosphes drew his sword. It was a rapier; the bladesmiths at Tarr-Hostigos had been swamped with orders for rapiers, since this crowd had learned that a sword has a point and that a thrust beats a swinging

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cut. He used his point now to trace the course of the West Branch—the Athan, here-and-now—from the otherwhen site of Muncy down to where Milton ought to be. The point rested on the river midway between them.

"Marax Ford," he said.

"Oh, no, Prince!" Chartiphon growled. "Go all the way around the mountain and all the way up East Hostigos? He won't do that. Here's where he'll try to come in."

He drew his own sword—long, heavy and double-edged, none of these newfangled pokers for him—and pointed to the juncture of Bald Eagle Creek and the river, at the site of Lock Haven.

"Listra Mouth," he said. "He can move his whole army west along the river, cross here—if we let him—and go up the Listra Valley to the Saski border. And that's where all our ironworks are."

Now that was something. Not so long ago, Chartiphon had taken weapons for granted. Now he was realizing they had to be produced.

That started an argument. Somebody thought Gormoth would try to force one of the gaps. Not Dombra—Antes Gap—that was too strong. Maybe Vryllos—McElhattan—or the gap back of where South Williamsport ought to be.

"He'll attack where he can best use his cavalry," young Harmakros, who was a cavalryman himself, declared. "That's what he has the most of."

That was true. Gormoth's cavalry superiority was something to worry, not to say be frightened, about.

"He'll attack where we don't expect him to."

That was Rylla, in male riding dress, a big dagger on her belt and a pheasant feather in her cap, leaning forward on the map table across from him.

Rylla was the nicest of many nice things, here-and-now. She was beautiful—blond hair almost shoulder-length, laughing blue eyes, impudent tilty little nose dusted with golden freckles—gay and fun-loving. She was utterly fearless; he'd first seen her riding into a cavalry skirmish at the head of her father's troopers. But best of all, after the wonderful very-best that she loved him and was going to marry him, the girl had a brain and wasn't afraid to use it.

"That's right," he agreed. "Where don't we expect him?"

"You know what that means?" Ptosphes asked. He had a pretty good brain, himself. "It means we'll have to be strong enough to resist everywhere." His rapier point swung almost from one end of the map to the other.

"With five thousand, and that counts boys with bows and arrows and peasant grandfathers with pitchforks?" Chartiphon demanded. "Don't joke about such things, Prince."

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It came to a little over that, but not much. Twenty-five hundred regular infantry, meaning organized into something like companies and given a modicum of drill, a thousand arquebusiers and calivermen, with fifteen hundred pikemen to keep the cavalry off them. Two thousand militia, peasant levies, anybody who could do an hour's foot-drill without dropping dead, armed with anything at all. And slightly less than a thousand cavalry, with steel cuirasses, helmets and thigh-guards. And against that, Prince Gormoth had four thousand of his own subjects, including neither the senile nor the adolescent and none of them armed with bows or agricultural implements, and six thousand mercenaries, of whom four thousand were cavalry.

"Then we'll just have to be able to move what men we have around faster," Rylla said.

Well, good girl! She'd grasped what neither her father nor Harmakros had, that mobility can make up for a numerical inferiority.

"Yes. Harmakros, how many horses can you find to mount our infantry? They don't have to be good horses, just good enough to get the men where they can fight on foot."

Harmakros was scandalized. Mounted soldiers were *cavalry;* anybody ought to know it took years to train a cavalryman. So was Chartiphon; infantry were *foot* soldiers, and had no business on horseback.

"It'll mean one out of four holding horses in a battle, but they'll get to the battle before it's over, and they can wear heavier armor. Now, how many infantry can we mount?"

Harmakros looked at him, decided that he was serious, and was silent for a while. It always took Harmakros a little to recover from the shock of a new idea. Then he grinned and nodded. "I'll find out," he said, grabbing the remount officer by the arm and pulling him off to the side. Rylla joined them with a slate and a piece of soapstone. Rylla was the math wizard; she'd learned how to do up to long division in Arabic numeration. While they argued, he began talking to Ptosphes and Chartiphon about artillery.

That was the one really hopeful thing about the situation. Here-and-now cannon didn't have trunnions. The guns were bedded into timbers like huge gunstocks, or timber frames for the heavier pieces. What passed for field artillery was mounted on four-wheeled carts, usually ox-powered. He blamed Styphon's House for that. They did the weaponeering, and they didn't want bloody and destructive wars, which were bad for business, or decisive wars which established peace, which were worse. They wanted a lot of little wars, all the time, to burn a lot of fireseed.

In the past two months, along with everything else and by methods which would have made Simon Legree look like the Model Em-

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ployer, he had ordered six new four-pounders built, with trunnions, on field carriages with limbers. Drawn by four horses apiece, they would keep up with cavalry on any sort of decent ground. He had also had trunnions welded onto some old pieces, mostly eight-pounders, and mounted them on makeshift field carriages. They would *not* keep up with cavalry, but they were five hundred per cent better than anything Gormoth had ever heard of.

They were still talking when Harmakros and Rylla came over.

"Two thousand," Rylla said. "They all have four legs. We think they were all alive yesterday evening."

"We'll need some for pack train and replacements. Sixteen hundred mounted infantry. Eight hundred arquebusiers, with arquebuses, not rabbit guns, and eight hundred pikemen, with pikes, not hunting spears or those scythe-blade things." He turned to Chartiphon. "Can you manage that?"

Chartiphon could. Men who wouldn't fall off their horses, too.

"And all the riflemen." Fifty of them, all the muskets and calivers and arquebuses he'd been able to get rifled to date. That was fifty more than the combined rifle strength of all five Great Kingdoms. "And five hundred cavalry, swords and pistols, no lances or musketoons."

Everybody heard that, and everybody howled. There weren't that many, not uncommitted. Swords flashed over the map, pointing to places where there were only half enough now. One of these days, somebody was going to use a sword in one of these arguments for something beside map-pointing. Finally, they scraped up five hundred cavalry for the new Mobile Force.

"You'll command," he told Harmakros. "You'll have all six four-pounders, and the best four eights. You'll be based in Sevenhills Valley; be ready at any notice to move either east or west from there."

"As soon as I get it organized, which will be tomorrow afternoon at latest, I'll be ready to go to Sevenhills. I can promise I'll be there by noon the next day."

That meant he'd be there before that; that was another thing about Harmakros.

"Oh, and before I forget." He addressed them all. "Battle cries." They had to be shouted constantly, to keep from being killed by your friends. "Beside 'Ptosphes!' and 'Hostigos!' we will also shout, *'Down Styphon!'* "

That met with general approval. They all knew who the real enemy was.

Gormoth, Prince of Nostor, set down the goblet and wiped his bearded lips on the back of his hand. The candles in front of him and down the long tables to the side flickered slightly. Tableware clattered, voices were loud.

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"Lost everything!" The speaker was a baron driven from Sevenhills Valley when Tarr-Dombra had fallen. "My house, a score of farms, a village—"

"You think we've lost nothing? They crossed at Vryllos and burned everything on my land; it was a Styphon's miracle I got out at all."

"For shame!" Vyblos the high priest cried rebukingly. "What of the Sevenhills temple farm, a holy place pillaged and desecrated? What of the blood of fifteen consecrated priests and novices and a score of lay guards, all cruelly murdered 'Dealt with as wolves are,' " he quoted.

"Well, we have an army, haven't we?" somebody at the side table on the left hectored. "Why don't we use it?"

Weapons clattered outside, and somebody else sneered, "That's Ptosphes, now; under the tables, everybody." A man in black leather entered, advancing and saluting; the captain of the dungeon guards.

"Lord Prince," he said, "the special prisoner will tell all."

"Ha!" He knew what that meant. Then he laughed at the anxious faces along the tables; not a few of his nobles dreaded the thought that somebody was telling all about something. He drew his poniard and cut a line across the candle in front of him; a thumbnail's length from the top.

"You bring good news. I'll hear him in that time."

He nodded in dismissal. As the captain backed away, he rapped loudly on the table with the dagger-pommel.

"Be silent, all of you. I've little time, so give heed." He turned to Klestreus, the elected captain-general of the mercenaries. "You have four thousand horse, two thousand foot, and ten cannon. Add to them a thousand of my infantry, choose which you will, and such cannon of mine as you need. You'll cross the river at Marax Ford. Be on the road before the dew's off the grass tomorrow before dawn the next day, take and hold the ford, put the best of your cavalry across, and let the others follow as speedily as they can.

"Netzigon," he addressed his own chief captain, "you'll gather every man you can, down to the very peasant rabble, and such cannon as Klestreus leaves you. With half of them, confront all the gaps into Nostor, from Nirfe up. You'll take the others opposite Listra-Mouth and Vryllos Gap. As Klestreus moves west through Hostigos, he will attack each gap from behind. When he does, your men will cross the river and attack from the north. Dombra we'll have to starve out; the rest must be stormed. When Klestreus is back of Vryllos Gap, the force you have at Listra-Mouth will cross and move up Listra Valley. After that, we'll have Tarr-Hostigos to take, Galzar only knows how long we'll be at that, but by the

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end of the moon-half, all else in Hostigos should be ours."

There was a gratified murmur along the tables; this made good hearing to all. Only the high priest, Vyblos, was ill-pleased.

"But why so soon, Prince?" he asked.

"Soon?" he roared. "By the mace of Galzar, you've been bawling for it like a weaned calf! Well, now you have your invasion; thank your god for it."

"A few more days would not be too much, Lord Prince," Vyblos said mildly. "Today I had word from Styphon's House Upon Earth, from the pen of His Divinity Himself. An Archpriest, His Holiness Krastokles, is coming here to Nostor, with rich gifts of fireseed and money, and the blessing of Styphon's Voice. It were poor reverence not to await His Holiness' coming."

He turned to the two captains. "You heard me," he said. "I rule here, not the priest. Be about it; send orders at once. You move tomorrow."

Then he rose, pushing back his chair before the servant could withdraw it. The line was still visible at the top of the candle.

Guards with torches attended him down the winding stairs into the dungeons. The air stank. His breath congealed; the heat of summer never penetrated here. From the torture chambers shrieks told of some wretch being questioned; idly he wondered who. Stopping at an iron-bound oaken door, he unlocked it with a key from his belt and entered alone, closing it behind him.

The room within was large, warmed by a fire on the hearth in the corner and lighted by a great lantern from above. Under it, a man bent over a littered table. He had a bald head and a straggling beard, and wore a most unprisoner-like dagger on his belt. A key for the door lay on the table, and a pair of heavy horseman's pistols. He straightened, turning.

"Greetings, Prince. It's done. I tried it; it's as good as they make in Hostigos, and better than the priests' trash."

"And no prayers to Styphon, Skranga?" he asked sarcastically.

Skranga was chewing tobacco. He spat brownly on the floor.

"In the face of Styphon! Try it yourself, Prince; the pistols are empty."

There was a dish half full of fireseed on the table. He measured in a charge, loaded and wadded a bullet on top of it, primed the pan and readied the striker, then fired into a billet of wood by the fire and went to probe the hole with a straw. The bullet had gone in almost a little finger's length; Styphon's powder wouldn't do that. He carried the pistol back and laid it on the table.

"Well, Skranga," he laughed. "You'll have to bide here a while,

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but from this hour you're first nobleman of Nostor after me. Style yourself Duke. There'll be rich lands for you in Hostigos, when Hostigos is mine."

"And the Styphon temple farm of Nostor," Skranga grinned. "If I'm to make your fireseed, there's all there that I'll need."

"Yes, that too, by Galzar! After I've downed Ptosphes, I'll deal with Vyblos, and he'll envy Ptosphes before I let him die."

Snatching up a pewter cup without looking to see if it were clean, he went to the wine keg and drew for himself, tasted the wine, then spat it out.

"Is this the swill they've given you?" he demanded. "By Galzar, whoever's at fault won't see tomorrow's sun set!" He flung open the door and bellowed into the hall: "Wine! Wine for Prince Gormoth and Duke Skranga! And silver cups! And see it's fit for nobles to drink!"

Mobile Force HQ had been the mansion of a Nostori noble driven from Sevenhills Valley on D-for-Dombra Day; his name had been shouted ahead as he rode through the troop-crowded village, and Harmakros and his officers met him at the door.

"Great Dralm, Kalvan!" Harmakros laughed, clasping his hand. "Are you growing wings on horses, now? Our messengers only got off an hour and a half ago."

"I know; I met them back of Vryllos Gap." They crossed the outer hall and through the doorway to the big room beyond. "We got the news at Tarr-Hostigos just after dark. What have you heard since?"

At least fifty candles burned in the great central chandelier. Evidently the cavalry had arrived here before the peasants, and hadn't looted the place too destructively themselves. Harmakros led him to an inlaid table on which a map, scorched with hot needles on white doeskin, was spread.

"We have reports from all the watchtowers along the mountain. They're too far back to see anything but dust, but the column's three miles long; first cavalry, then infantry, then wagons and guns, and then more infantry and cavalry. They halted at Nirfe at dusk and built hundreds of campfires. Whether they left them burning and marched on after dark, and how far ahead the cavalry are, we don't know. We expect them at Marax Ford by dawn."

"We got a little more than that. The priest of Dralm at Nostor Town got a messenger off a little after noon; it was dusk before he could get across the river. Your column's commanded by Klestreus. Four thousand mercenary cavalry, two thousand mercenary infantry, a thousand of Gormoth's infantry, fifteen guns, he didn't say what kind, and a wagon train that must be creaking with loot. At the same

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time, Netzigon's moving west, probably toward Listra-Mouth and we don't know what with. The messenger had to dodge his troops all the way up to Vryllos. Chartiphon's going to Listra-Mouth with what he can scrape up; Prince Ptosphes is occupying Vryllos Gap."

"That's it; a double attack," Harmakros said. "We can't help Chartiphon, can we?"

"We can help him by beating Klestreus." He got out his pipe; as soon as he had filled it, one of the officers provided a light. "Thank you. What have you done so far?"

"I started my wagons and the eight-pounders down the main road. They'll stop just short of Fitra, here"—he pointed on the map—"and wait for us. As soon as I'm all collected, I'm taking the cavalry and mounted infantry and the four-pounders down the back road. After we're on the main road, the wagons and the eights will follow on. I have two hundred militia, the usual odds-and-ends, marching with the wagons."

"That was smart."

Puffing on his pipe, he looked at the map. The back road, adequate for horsemen and the four-pounders but not for wagons, followed the mountains and then bent south away from them to join the main valley road at the village of Fitra. Harmakros had started his slow stuff first, and could overtake without being impeded by it, and he was waiting till he had all his striking force in hand and not dribbling it in to be chopped up by detail.

"Where had you thought of fighting?"

"Why, on the Athan, of course." Harmakros was surprised that he should ask. "Klestreus will have some cavalry over before we get there, that can't be helped, but we'll wipe them out or chase them back, and then defend the line of the river."

"Huh-uh." He touched the Fitra road-junction with his pipe stem. "We fight here."

"But that's miles inside Hostigos!" one of the officers cried. Maybe he owned an estate down there. "We can't let them get that far."

"Lord Kalvan," Harmakros began stiffly. He was going to be insubordinate, he never bothered with titles otherwise. "We must not give up one foot of ground; the honor of Hostigos forbids it."

Here we are, back in the Middle Ages! He seemed to hear the voice of a history professor, inside his head, calling a roll of battles lost on points of honor. Mostly by the French; they'd been the worst, though not the only, offenders. He decided to fly into a rage.

"To Styphon with that!" he yelled, banging his fist on the table. "Honor won't win this war, and real estate won't win this war. The only thing that'll win this war is killing Nostori!

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"Now here," he continued, quietly, the rage having served its purpose, "is where we can kill the most of them, and get the fewest of our own men killed doing it. Klestreus will cross the Athan here, at Marax Ford." That would be a little below where he remembered Watsontown to have been. "He'll rush his best cavalry ahead to secure the ford, and the rest of the cavalry will cross next. They'll want to get in on the best looting ahead of the infantry; they'll push ahead without waiting. By the time the infantry are over, they'll be stringing west in bunches.

"Now, that army Klestreus has could walk all over us, if they were all together. But they won't be. And they'll be tired, and we'll have reached Fitra by daylight, have our position prepared, our men and horses will be rested, we'll even be able to give everybody a hot meal. And Klestreus will be strung out for ten miles by the time his advance elements come up to us. Now, what kind of troops have we east of here?"

"A hundred cavalry along the river, and a hundred and fifty regular infantry and about twice as many militia; about five hundred, militia and regulars, at posts in the gaps."

"All right; get riders off at once. Somebody who won't be argued with. Have all that force along the river moved back; to Fitra if possible, and if not they can reenforce the posts at the gaps. The gaps'll have to look out for themselves, we can't help them. The cavalry will keep just in front of Klestreus, skirmishing but doing nothing to delay him."

Harmakros looked at the map, thought for a little, and nodded.

"East Hostigos," he said, "will be the graveyard of the Nostori."

That was all right; that took care of the honor of Hostigos.

"Well, mercenaries from Hos-Agrys and Hos-Ktemnos, anyhow." That reminded him of something. "Who hired those mercenaries; Gormoth, or Styphon's House?"

"Why, Gormoth. The money came from Styphon's House, but the mercenaries contracted with Gormoth; they serve him."

"The reason I asked, the Rev. Whatshisname in Nostor included a bit of gossip in his message. It seems that this morning Gormoth had one of his under-stewards put to death. Had a funnel forced into his mouth and half a keg of wine poured into him. The wine was of inferior quality, and had been given to a prisoner for whom Gormoth had commanded good treatment."

One of the officers made a face. "Sounds like Gormoth," he commented. Another laughed and said he could think of a few tavern keepers in Hostigos Town who deserved that.

"Who was the prisoner?" Harmakros asked. "Count Pheblon?"

"Oh, no. Pheblon's out of favor, but he isn't a prisoner. You know

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this fellow. Agrysi horse-trader named Skranga."

"Yes, he got caught in Hostigos during the Iron Curtain." Like Fifth Column, Iron Curtain was now part of the Hostigi vocabulary. Then he blinked. "He was working in the fireseed mill, while he was here! You think he might be making fireseed for Gormoth?"

"He is if he's doing what I told him to." There was an outcry at that. He laughed. "And if Gormoth begins making his own fireseed, Styphon's House'll hear about it, and you know what'll happen then. That's why I asked about those mercenaries. I was wondering whether Gormoth would use them against Styphon's House, or Styphon's House against Gormoth." He shrugged. "Not that it matters. If everybody does his job tomorrow, nobody'll use those mercenaries. Except, maybe, us. That's another thing. We don't bother with Nostori prisoners, but take all the mercenaries who'll surrender. We may need them later."

Dawn was only a pallor in the east, and the whitewashed walls were blurs under dark thatches, but the village of Fitra was awake, light pouring from open doors and a fire blazing on the small common. There was a crowd, villagers, and cavalrymen who had ridden ahead. Behind him, hoofs thudded and armor and equipment clattered; away back, he could hear the four-pounders thumping over the pole bridge at the mill. The shouting started, of course: "Lord Kalvan! Dralm bless Lord Kalvan!" He was used to it, now; it didn't give him the thrill it had at first. He had to make a speech, while orders were shouted and re-shouted to the rear, and men and horses got off to the sides of the road to make way for the guns.

Then he and Harmakros and four or five of the officers turned left and cantered down the main road, reining in where it began to dip. The eastern pallor had become a bar of yellow light. The Mountains of Hostigos were blackly plain on the left, and the jumble of ridges to the right were taking shape. Nearby trees began to detach themselves from the obscurity. In a few hours, they'd all be down. He pointed to the right.

"Send two hundred cavalry around that ridge, over there, to where those three farms are clumped together," he told Harmakros. "They're not to make fires or let themselves be seen. They're to wait till we're engaged and the second mob of Nostori cavalry come up; then they'll come out and hit them from the flank and rear."

An officer galloped away to the rear to attend to it. The yellow light was spreading upward in the east, only the largest and brightest stars were still visible. In front, the ground fell away into a little hollow, with a brook running through it to the left, to join a larger stream at the foot of the mountain, which

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rose steeply, then sloped up to the summit. On the right was broken ground, mostly wooded. A few trees around them, in the hollow, and on the slope beyond; open farmland in front. This couldn't have been better if he'd had Dralm create it to order.

The yellow light was past the zenith, and the eastern horizon was a dazzle. Harmakros squinted at it and said something about fighting with the sun in their eyes.

"No such thing; it'll be overhead before they get here. Now, you go take a nap. I'll wake you in time to give me some sack-time. As soon as the wagons get here, we'll give everybody a hot meal."

An ox cart appeared on the brow of the little hill across the hollow, piled high, a woman and a boy trudging beside the team and another woman and more children riding. Before they were down to where the road crossed the stream, a wagon was coming up.

"Have them turned aside," he ordered. "Don't let them get into the village." This was only the start; there'd be a perfect stream of them before long. They couldn't be allowed on the main road past Fitra, not till the wagons and the eight-pounders got through. "And use wagons for barricades, and the oxen to help drag trees."

The village peasants were coming out, now, leading four- and six-ox teams, chains dragging. Axes began thudding. One thing, if anybody was alive here then, this village wouldn't have to worry about winter firewood. More refugees were coming in; loud protests at being diverted, and at the seizure of wagons and teams. The axemen were across the hollow, now, and men shouted at straining oxen as trees were dragged in to build an abatis.

He strained his eyes against the sunrise; he couldn't see any smoke. Too far away. He was sure, though, that the mercenary cavalry was across the Athan, and they ought to be burning things. Pyromania was as fixed in the mercenary character as kleptomania. Of course, he could be misjudging here-and-now mercenaries; all he knew was what he'd learned reading Sir Charles Oman's "History of the Art of War," when he should have been studying homiletics and scriptural exegesis and youth-organization methods at college, but there were universal constants. One was that mercenary soldiers' hearts were full of larceny. Another was that they liked being alive to spend their loot. He was pretty confident of what Klestreus' cavalry were doing down toward the river.

The abatis began to take shape, trees dragged into line, the tops to the front, with spaces for three of the four-pounders on either side of the road, and a barricade of peasants' wagons at either end. He rode forward a couple of times, to get an enemy's eye-view of it; he didn't

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want it to look too formidable. He made sure that none of the guns would be visible. Finally, he noticed smears of smoke against the horizon, maybe five or six miles down the valley. Klestreus' mercenaries weren't going to disappoint him, after all.

A company of regular infantry, a hundred and fifty, three pikes to two calivers, came up in good order. They'd marched all the way from the Athan, reported firing behind them, and were disgusted at marching away from it. He told them they'd get all the firing they wanted by noon, and to fall out and rest. A couple of hundred militia dribbled in, some with crossbows. There were a few more smokes in the east, but he still couldn't hear anything. At seven-thirty, the supply wagons and the eight-pounders, and the two hundred militia wagon-guards, came in from the west. That was good; the refugees, now a steady stream, could be sent on up the main road.

He found Harmakros asleep in one of the village cottages, wakened him, and gave him the situation to date.

"Good; I'll get the men fed. When do you want me to wake you?"

"As soon as you see smoke two miles down the valley, as soon as our cavalry from the east begin coming in, and in any case in two hours."

Then he pulled off his boots and helmet, unbuckled his belt, and lay down in the rest of his armor on the cornshuck tick Harmakros had vacated, hoping that it had no small inhabitants or, if so, that none of them would move in under his arming-doublet. It was comparatively cool in here, behind the stone walls and under the thick thatch; the wet heat of his body became a clammy chill. He shifted positions a couple of times, finally deciding that fewer things dug into him if he lay flat on his back.

So far, everything had gone nicely; all he was worried about was who would let him down, and how badly. If some valiant fool got a rush of honor to the head and charged at the wrong moment—

If he could bring this off just half as well as he'd planned it, which would be about par for the course for any battle, he could go to Valhalla when he died and drink at the same table with Richard Coeur-de-Lion and the Black Prince and Henry of Navarre. A complete success would entitle him to take a salute from Stonewall Jackson. He fell asleep receiving the commendation of George S. Patton.

An infantry captain wakened him a little before ten.

"They're burning Systros, now." That was a town, about two thousand, two and a half miles away. "A couple of the cavalry who've been keeping just in front of them came in. The first batch are about fifteen

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hundred; there's another lot, maybe a thousand, two miles behind them. We don't know where the infantry and the wagons are, but we've been hearing those big bombards at Narza Gap."

That would be Klestreus' infantry on this side, probably supported by Netzigon's ragtag-and-bobtail from the other side. He pulled on his boots and buckled on his sword, and, after eating a bowl of beef stew with plenty of onion in it, he put on his helmet and drank a mug of wine. Somebody brought his horse, and he rode up to the line. On the way, he noticed that the village priest of Dralm and the Mobile Force priest of Galzar had set up a field hospital on the village common and that pole-and-blanket stretchers were being prepared. No anesthetics, here-and-now, though the priests of Galzar used sandbags. He hoped he wouldn't be wounded, himself. The last time had been bad enough.

A big column of smoke dirtied the sky above Systros. Silly buggers; first crowd into it had fired it, here-and-now mercenaries were the same as any other, and now the ones behind would have to bypass it. They'd be handling Klestreus' army in retail lots.

The abatis was finished, over a hundred felled trees ox-dragged into line, butts to the rear and tops to the front. Between them, men sat smoking or eating, or lay on the ground resting. The horse lines were back of the side road, with the more poorly-armed militiamen holding horses. At each end of the abatis were two of the four eight-pounders, then an opening big enough for cavalry to sortie out through, and then barricades of farm carts.

He could hear a distant, and then not so distant, popping of small arms. Away off, one of the bombards at Narza Gap boomed, and, after a while, the other. Good; they were still holding out. Cavalry came drifting up the road, some reloading pistols. The shots grew louder, and more cavalry, in more of a hurry, arrived. Finally, a dozen or so topped the rise across the hollow and galloped down; the last one fired a pistol over his shoulder. By the time he was splashing across the brook, Nostori cavalry appeared, ten or fifteen of them.

Immediately, an eight-bore rifled musket bellowed from behind the abatis. His horse dance-stepped daintily; another; and another, roared. Across the hollow, a horse went down kicking, and another just went down. Another, with an empty saddle, trotted down to the stream and stopped to drink. The Nostori turned and galloped back out of sight. Nobody else had fired; riflemen were a law to themselves, but the arquebusiers were waiting for orders. He was wondering where the rest of the rifles were when a row of white smoke puffs blossomed along the edge of the bench above the creek on the left,

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and shots banged like a string of firecrackers. There were yells from out of sight across the hollow, and musketoons thumped in reply.

Wasting Styphon's good fireseed; four hundred yards, they couldn't hit Grant's Tomb at that range with smoothbores. Along the abatis, everybody was on his feet, crowding into position; there were a few yells of "Hostigos!" and "Down Styphon!" More confused noise from the dead ground beyond the brow of the other hill, a steady whip-cracking of rifles, fired as fast as they could be reloaded and aimed, from the bench. He wished he had five hundred rifles up there.

Hell, while he was wishing, why not wish for twenty medium tanks and a dozen Sabre-Jets?

Then the mercenary cavalry came up in a solid front on the brow of the hill, black and orange lance-pennons and helmet-plumes and scarves, polished breastplates. Lancers all in front, musketoon-men behind. A shiver ran along the line as the lances came down; the advance paused to dress front.

As though that had been the signal, which it had been, six four-pounders and four eight-pounders went off as one, not a noise but a palpable blow on the ears. His horse started to buck; by the time he had him under control again, the smoke was billowing out over the hollow, and several perfect rings floated up against the blue, and everybody was yelling, *"Down Styphon!"*

Roundshot; he could see the furrows it had plowed into the block of black and orange cavalry; men yelling, horses rearing, or down and screaming horribly as only wounded horses can. The charge had stopped, briefly, before it had started. On either side of him, gun captains were shouting, "Grapeshot! Grapeshot!" and cannoneers were jumping to their pieces before they had stopped recoiling with double-headed swabs, one end wet to quench lingering powder-bag sparks and the other dry.

The charge slid forward in broken chunks, down the dip into the hollow. When they were twenty yards short of the brook, four hundred arquebuses blazed; the whole front went down, horses behind tripping over fallen horses in front. The arquebusiers stepped back, drawing the stoppers of their powder flasks with their teeth. *Memo: self-measuring spring powder flask; start making them as soon as possible.* When they were half reloaded, the other four hundred arquebuses crashed. The way those cavalry were jammed, down there, every bullet must have hit something. The smoke was clogging the hollow like spilled cotton, now; through it he could see another wave of cavalry come up on the brow of the hill. A four-pounder spewed grape into them, and then another. *Down Styphon!* Before they could begin the descent, another four-pounder went off.

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Gustavus Adolphus' four-pounder crews could load and fire faster than musketeers, a dry lecture-room voice was telling him. Lord Kalvan's weren't doing quite that well, but almost. The first one had fired close on the heels of the third arquebus volley. Then one of the eight-pounders fired, and that was a small miracle.

A surprising number of Klestreus' cavalry had survived the fall of their horses. Well, horses were bigger targets, and they didn't wear breastplates. Having nowhere else to go, they were charging up on foot, their lances for pikes. Some of them were shot in front of the abatis, quite a few were piked trying to get through it. A few did get through. As he galloped to help deal with one party of these, he could see militiamen with scythe-blade things, he had never decided on the correct name for those weapons, and billhooks and axes, running forward from the horse lines. At that moment, a trumpet sounded on the right, and another on the left, and there were great shouts of *"Down Styphon!"* at both ends. Harmakros and the cavalry.

Then he was in front of a dozen Nostori mercenaries, pulling up his horse and aiming a pistol at them.

"Yield, comrades! We spare mercenaries!"

An undecided second and a half, then one raised his reversed musketoon over his head.

"We yield; oath to Galzar."

That they would keep. Galzar didn't like oath-breaking soldiers; he always let them get killed at the next opportunity. *Memo: cult of Galzar; encourage.*

Some peasants ran up, brandishing axes. He waved them back.

"Keep your weapons," he told the mercenaries. "I'll find somebody to guard you."

He found a couple of Mobile Force arquebusiers, and then had to save a couple more mercenaries from having their throats cut. Damn these civilians! Have to detail prisoner guards. Disarm the mercenaries, and the peasants would butcher them; leave them armed in the rear, and maybe the temptation would be too great even for the fear of Galzar.

Along the abatis, the firing had stopped, but the hollow below was a perfect hell's bedlam—*Down Styphon!* and, occasionally, *Gormoth!* Pistol shots, clashing steel. Over his shoulder, he could see villagers, even women and children, replacing the militia at the horse lines. Captains were shouting, "Pikes forward," and pikemen were dodging out among the felled trees. Dimly, through the smoke, he saw red and blue colors on horsemen at the brow of the opposite hill. The road had been left open; he trotted forward and down toward the brook.

What he saw in the hollow made his stomach heave. After being demob-ed on the West Coast, he had

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made a side trip into Mexico on the way home, and seen a bullfight in Juarez. One horse gored to death by a bull hadn't bothered him much, but this would have sickened the most hardened *aficionado*. The infantrymen, going forward, were stopping to brain wounded horses or cut their throats or shoot them with pistols from saddle holsters. They oughtn't to stop to do that, but he couldn't blame them. The Hostigi soldier was a farmer and couldn't let horses suffer.

Stretcher-bearers were coming forward, too, and so were villagers to loot. Corpse-robbing was the only way the civil population, here-and-now, had of getting some of their own back after a battle. Most of them had clubs or hatchets, to make sure that what they were robbing really were corpses. A lot of good weapons lying around, too. They ought to be collected before they rusted into uselessness, but no time to do that now. Stopping to do that, once, had been one of Stonewall Jackson's few mistakes.

Away ahead, there was another uproar of battle, and more *Down Styphon!* That would be the two hundred cavalry from the far right hitting the second batch of mercenaries, who would be disorganized, by now, by fugitives from the fight at the hollow. Gormoth wasn't going to have to pay a lot of mercenaries, if this kept up. The infantry were beginning to form up on the opposite hill, blocks of pikemen with smaller blocks of arquebusiers between, and some were running back to fetch the horses. And Nostori cavalry were coming in in small groups, holding their helmets up on their sword points and crying, "We yield; oath to Galzar." One of the officers of the flanking party, with four men, was bringing in close to a hundred of them. He was regretful that so many had escaped. The riflemen on the bench were drifting east, firing as they went. All the infantry from the Athan and many of the militia had mounted themselves on captured horses.

There was a clatter behind him, and he got his horse off the road to let the four-pounders pass in column. Their captain waved to him and told him, laughing, that the eights would be along in a day or so.

"Where do we get some more shooting?" he asked.

"Down the road a piece. Just follow along; we'll show you."

He looked at his watch. It was still ten minutes till noon, Hostigos Standard Sundial Time.

By 1700, they were well down the road, and there had been a lot of shooting on the way. Now they were two miles west of the Athan, where Klestreus' wagons and cannon were strung out for half a mile each way along the road, and he was sitting, with his helmet off, on an upended wine keg, at a table made by laying a shed door across a couple of boxes, with Harmakros'

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pyrographed doeskin map spread in front of him and a mug where he could reach it. There were some burned-out farm-buildings beside the road, and the big oaks which shaded him had been yellowed on one side by the heat. Several hundred prisoners were squatting in the field beyond, eating food from their own wagons. Harmakros, and the chief captain of mounted infantry, he'd be about two-star rank, and the major-equivalent Galzar chaplain, and the brigadier in direct command of the cavalry, sat or squatted around him. The messenger from Sevenhills Valley, who had just caught up with him, was trying to walk the stiffness out of his legs, carrying a mug from which he drank as he paced and talked.

"That's all we know," he said. "All morning, there was cannon fire up the river, and then small-arms fire, a lot of it, and when the wind was right, we could hear shouting. A little after noon, some cavalry who had been patrolling the strip between the river and the mountain came in; they said Netzigon was across in force in front of Vryllos Gap, and they couldn't get through to Ptosphes and Princess Rylla."

He cursed; some of it was comprehensible in local cursing terms. "Is she at Vryllos, too?"

Harmakros laughed. "You ought to know her by now, Kalvan. Try and keep that girl out of a battle."

He'd probably be doing that the rest of his life. Or hers, which mightn't be so long, if she wasn't careful. The messenger stopped, taking a deep drink, then continued:

"Finally, a rider came in from this side of the mountain. He said that the Nostori were over the river and pushing Prince Ptosphes back into the gap. He wanted to know if the captain at Tarr-Dombra could help him."

"Well?"

"We only had two hundred regulars and two hundred and fifty militia, and it's ten miles up to Vryllos along the river, and the Styphon's own way around the mountains on the south side. So the captain left a few cripples and kitchen women to hold the castle, and took everything else he had across the river. They were just starting when he sent me off. I heard cannon fire when I was crossing Sevenhills Valley."

"That was about the best thing he could do."

There'd be a couple of hundred Nostori at Dyssa—about Jersey Shore—just a holding force. If they could run them out, burn the town, and start enough of a scare, it might take some of the weight off Ptosphes at Vryllos and Chartiphon at Listra-Mouth.

"I hope nobody expects any help from us," Harmakros said. "Our horses are ridden into the ground; half our men are mounted on captured horses, and they're in worse shape now than the ones of our own we have left."

"Some of my men are riding two

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on a horse," Phrames, the mounted infantry CO, said. "You figure what kind of a march they can make."

"It would be midnight before any of us could get to Vryllos Gap," he said. "That would be less than a thousand."

"Five hundred, I'd call it," the cavalry brigadier said. "We've been losing by attrition all the way east."

"But I'd heard that your losses had been very light."

"You heard? From whom?"

"Why, from the men guarding prisoners. Great Dralm, Lord Kalvan, I never saw so many—"

"That's our losses; prisoner-guard details, every one as much out of it as though he'd been shot through the head."

But Klestreus' army had simply ceased to exist. It was not improbable that as many as five hundred had safely crossed the Athan at Marax Ford. There would be several hundred more, singly and in small bands, dodging through the woods to the south. And some six hundred had broken through at Narza Gap. The rest had either been killed or captured.

First, there had been the helter-skelter chase east from Fitra. For instance, twenty-five riflemen, firing from behind trees and rocks, had stopped and turned back two hundred cavalry who were making for the next gap down. Mostly, anybody who was overtaken held up an empty hand or a reversed sword and invoked Galzar. He only had to fight once, himself; he and two Mobile Force cavalrymen caught up with ten fleeing mercenaries and charged them, shouting to them to yield. Maybe the ten were tired of running, maybe they thought it was insulting for three men to try to capture them, or maybe they were just contrary. Instead, they had turned and charged. He had half-dodged and half-parried a lance and spitted the lancer through the throat, and had been thrusting and parrying with two swordsmen when a dozen mounted infantrymen came up.

Then, they had fought a small battle half a mile west of Systros. Fifteen hundred infantry and five hundred cavalry, all mercenaries, had just returned to the main road after passing around both sides of the burning town and were forming up when the wrecks of the cavalry from Fitra had come pelting into them. Their own cavalry and the fugitives were trying to force a way of escape, and the infantry were trying to pike them off, when the Hostigi arrived, mounted infantrymen dismounting to fight on foot. Then the four-pounders arrived and began throwing case-shot, leather tubes full of pistol bullets. Gormoth's mercenaries had never been exposed to case-shot before. Several hundred were killed, and the rest promptly hoisted their helmets, tore off Gormoth's colors, and cried for quarter.

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That had been where the mercenary general, Klestreus, had surrendered. Phrames had attended to that; he and Harmakros had kept on with the cavalry, now down to three hundred, pistoling and cutting down fugitives. A lot of these turned left toward Narza Gap.

Hestophes, the Hostigi CO there —about United States captain equivalent, he'd be a full colonel this time tomorrow—had been a real cool cat. He'd had two hundred and fifty men, mostly regulars with calivers, two old twenty-pound bombards, and several smaller pieces. Klestreus' infantry had attacked Nirfe gap, the one below him, and, with the aid of Netzigon's men from the other side, had swamped it. A few survivors had escaped along the mountain top and brought the news to Narza. An hour later, Hestophes' position was under attack from both sides, too.

He had beaten off three assaults, a probable total of a thousand men. Then his lookout on the mountain reported seeing the Fitra-Systros fugitives streaming east. Hestophes promptly spiked his guns and pulled his men up out of the gap. The infantry who had been besieging him were swept along with the fleeing cavalry; from the mountainside, Hestophes spattered them with caliver bullets to discourage loitering and let them escape to spread panic on the other side. By now, they would be spreading it in Nostor Town.

Fitra had been a turkey shoot, Systros had been a roundup, and the rest of it had been a fox hunt. Then they had run into the guns and wagon train, inching along under ox power. There had been, with the train, a thousand of Gormoth's own infantry, and five hundred mercenary cavalry. This had been Systros all over, but a massacre. The fugitive cavalry had tried to force their way through, the infantry had resisted, and then the four-pounders—only five, one was off the road below Systros with a broken axle—had arrived and begun firing case-shot, and then one of the eight-pounders arrived. Some of the mercenaries tried to put up a serious fight; when they found the pay chests in one of the wagons they understood why. The Nostori infantry simply emptied their calivers and threw them away and ran. Along with *Down Styphon!* the pursuers were now shouting, *Dralm and No Quarter!* He wondered what Xentos would have thought of that. Dralm wasn't supposed to be that kind of a god.

"You know," he said, getting out his pipe and tobacco, "we didn't have a very big army to start with. Just what do we have now?"

"Five hundred here, and four hundred at the river," Phrames said. "The rest are guarding prisoners all the way back to Fitra."

"Well, I think we can help Ptosphes and Chartiphon best from here," he said. "That gang Hesto-

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phes let through at Narza will be panting out their story all the way to Nostor Town." He looked at his watch again. If he ever broke that thing, he'd be sunk! "By this time, Gormoth will be getting ready to fight the Battle of Nostor." He turned to Phrames. "How many men do you absolutely need, here?" he asked. "Two hundred?"

Phrames looked up and down the road, and at the prisoners in the field, and then, out of the corner of his eye, at the boxes under the shed door that formed the table top. They hadn't got around to weighing all that silver yet, but there was too much to be careless with.

"I ought to have twice that many, Lord Kalvan."

"The prisoners are mercenaries, and they have agreed to take Prince Ptosphes' colors," the priest of Galzar said. "Of course, they cannot bear arms against Gormoth or against any in his service until released from their oaths to him by the end of the war. In the sight of the Wargod, helping you to guard these wagons would be bearing arms against Gormoth, for it would free your own soldiers to do so. But I will speak to them, and I will answer that they will not break their oath of surrender. You will need no guards for them."

"Two hundred, then," Phrames said. "I can use walking wounded for some things."

"All right; take two hundred, the ones with the worst beat up horses, and mind the store. Harmakros, you take three hundred and two of the four-pounders and cross at the next ford down. I'll take four hundred across at Marax and work east and north. You can divide into two columns of a hundred men and one gun apiece, but no smaller. There will be companies and parts of companies over there trying to reform. Break them up. And burn the whole country out, set fire to everything that'll make a smoke, or a blaze after dark. Any refugees going north, give them a good scare, but don't stop them. We want Gormoth to think we have three or four thousand men across the river. That'll take the pressure off Vryllos Gap and Listra-Mouth."

He rose, and Phrames took his seat. Horses were brought; he and Harmakros and the others mounted. The messenger from Sevenhills Valley refilled his mug and sat down, stretching his legs in front of him. He rode along the line of wagons, full of food the people of Nostor wouldn't eat this winter, and curse Gormoth for the lack, and kegs of fireseed the slaves in Styphon's temple farms would have to toil to replace. He came to the guns, and saw one at which he stopped. A long brass eighteen-pounder, on a two-wheeled cart, with a four-wheeled cart for ammunition and to support the tail of the heavy timber stock. There was another behind it, and an officer in gilded armor sitting on the cart, morosely smoking a pipe.

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"Your guns, captain?" he asked.

"They were. Prince Ptosphes' guns, now."

"They're still yours, and good pay for their use. Gormoth of Nostor isn't our only enemy."

The mercenary artilleryman grinned. "Then I'll take Ptosphes' colors, and my guns with me. You're Lord Kalvan? Is it really true that you make your own fireseed?"

"What do you think we were shooting at you today, sawdust?" He looked at the guns again. "We don't see brass guns around here."

They'd been made, as he suspected, in Zygros. He looked at them again, critically; there wasn't a thing wrong with Zygrosi brass-casting. The captain was proud of them, and glad he wasn't going to lose them; he boasted about good shots they had made.

"Well, you'll find one of my officers, Count Phrames, back by that burned house and those big trees. Tell him I sent you. He's to do what he can to help you get those guns to Hostigos Town. Where are your men?"

"Some of them got killed, before we cried quits. The rest are back there with the others. They'll all take the red and blue along with me."

"I'll talk to you later. Good luck, captain, and glad to have you with us."

There were dead infantry all along the road, mostly killed from behind, while running. Infantry who stood firm had a chance, usually a very good one, against cavalry. Infantry who ran had none at all. It grew progressively worse until he came to the river, where the four-pounder crews were swabbing and polishing their pieces, and dark birds rose cawing and croaking and squawking when disturbed at their feast. Must be every crow and raven and buzzard in Hos-Harphax; he even saw a few eagles.

And the river, horse-knee deep at the ford, was tricky. Crossing, their mounts stumbled continuously on armor-weighted corpses. This one had been a real baddie for Nostor.

"So your boy did it, all by himself," the lady history professor was saying.

Verkan Vall nodded, grinning. They were in a seminar room at the University, lounging in seats facing a big map of Fourth Level Aryan-Transpacific Hostigos, Nostor, northeastern Sask and northern Beshta.

"Didn't I tell you he's a genius?"

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"Just how much genius did it take to lick a bunch of klunks like that?" the operations director challenged. "From all the reports I got on it, they licked themselves."

"Well, a great deal, accurately to predict the mistakes they'd make, and then plan to take advantage of them," the elderly professor of paratemporal probability theory pronounced. He saw it as a brilliant theoretical accomplishment, vindicated by experiment. "I agree with Chief's Assistant Verkan; the man is a genius. Wait till we get this worked up a little more completely!"

"He knew the military history of his own time line," the historian said. "And he knew how to apply it." She wasn't going to let her own subject be ignored. "Actually, I think Gormoth planned a good campaign—against Ptosphes and Chartiphon. Without Kalvan, they'd never have won."

"Well, Ptosphes and Chartiphon fought a battle of their own and won, didn't they?"

"More or less. Netzigon was supposed to wait across the river till Klestreus got up to Vryllos Gap, but Chartiphon started cannonading him—ordnance engineering by Kalvan—and Netzigon couldn't take it."

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"Well, why didn't he pull back out of range? He knew Chartiphon couldn't get his cannon over the river."

"Oh, that wouldn't have been honorable. Besides, he didn't want the mercenaries to win the war, he wanted the honor of winning it."

"How often I've heard *that* one!" the historian laughed. "But don't the Hostigi go in for this honor jazz, too? On that cultural level—"

"Sure, till Kalvan talked them out of it. As soon as he started making better-than-Styphon's powder, he gained a moral ascendancy over them. Indispensable Man. And then, the new swordplay, the new tactics, the artillery improvements; now it's 'Trust Lord Kalvan; Lord Kalvan is always right.' "

"He'll have to keep working at that. He won't dare make any mistakes. But what happened to Netzigon?"

"He made three attempts to cross a hundred yards of river in the face of an artillery superiority. That was when he lost most of his cavalry. Then he threw his infantry across at Vryllos, pushed Ptosphes back into the gap, and started a flank attack on Chartiphon up the south bank of the river. Ptosphes didn't stay pushed; he counter-attacked and flanked Netzigon. Then the girl, Rylla, took a hundred-odd cavalry across, burned Netzigon's camp, slaughtered a lot of camp followers, and started a panic in Netzigon's rear."

"That was too bad about Rylla," the lady historian said.

He shrugged. "That can happen in battles, any size. That's why Dalla's always worried when she hears I've been in one. Well, then everything went to pieces and the pieces began breaking up. We had a couple of conveyors in on antigrav last night. They had to stay above twenty thousand feet, we didn't want any heavenly portents on top of everything else, but they got some good infrared telephoto pictures. Fires all over the western end of Nostor, and for a two-mile radius around Dyssa, and in the southeast, that was Kalvan and Harmakros. And a lot of entrenching and fortifying around Nostor Town; Gormoth thinks he's going to have to fight the next battle there."

"That's ridiculous!" the operations director declared. "It'll be a couple of weeks before Kalvan has his army reorganized, after those two battles. And powder; how much do you suppose he has left?"

"Five or six tons. That just came in a little after noon, from our people in Hostigos Town. After he crossed the river, Harmakros captured a wagon train. An Archpriest of Styphon's House, on his way to Nostor Town, with four tons of fireseed for Gormoth—and seven thousand ounces of gold."

The operations director whistled. "Man! That's making war support war, now!"

"And another ton or so in Kles-

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treus' supply train, and Klestreus' pay chest," he added. "Hostigos came out of this deal pretty well."

"Wait till we get this all worked up," the paratemporal probability theorist was cackling. "Absolute proof of the decisive effect of one superior individual on the course of history. Kalthar Morth and his Historical Inevitability, and his vast, impersonal, social forces, indeed!"

Gormoth of Nostor stood with an arm over his companion's shoulder —nobly clad, freshly bathed and barbered, with a gold chain about his neck, Duke Skranga looked nothing like the vagrant horse trader who had come to Nostor half a moon ago. Together they stared at the crowd in the Presence Chamber. Netzigon, who had come stumbling in after midnight with all his guns and half his army lost and the rest a frightened rabble; his cousin Pheblon, his ransom still unpaid; the nobles of the Elite Guard who had attended him yesterday, waiting with him for news of victory until news of defeat had come; three officers of Klestreus' mercenaries who had got through Narza Gap, and several more who had managed to cross at Marax Ford alive. And Vyblos, the high priest, and with him Krastokles, the Archpriest of Styphon's House Upon Earth, and his black-armored guard captain, who had arrived with half a dozen men on broken-down horses at dawn.

He hated the sight of all of them, and the two priests most of all, and wasted no words on them.

"This is Duke Skranga. Next to me, he is first nobleman of Nostor. He takes precedence of all here." The faces in front of him went slack with amazement, then stiffened angrily. A mutter of protest was hushed almost as it began. "Do any object? Then he'd better be one who's served me half as well as Skranga, and I see none such here." He turned to Vyblos. "What do you want here, and who's this with you?"

"His Sanctity the Archpriest Krastokles, sent by His Divinity Styphon's Voice," Vyblos began angrily. "And how has he fared, coming here? Set upon by Hostigi heathens, hounded through the hills like a deer, his people murdered, his wagons pillaged—"

"His wagons, by the mace of Galzar! My gold and fireseed, sent me by Styphon's Voice in his care, and look how he cared for it! He and Styphon between them!"

"Blasphemy!" A dozen voices said it at once. Vyblos', and Krastokles', and the guard captain's. And, among others, Netzigon's.

Now, by Galzar, didn't he have a fine right to open his mouth here? Anger sickened him; in a moment he thought he would vomit pure bile. He strode to Netzigon, snatching the golden chief captain's chain from over his shoulders and striking him in the face with it, reviling

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him with obscenity upon malediction.

"Out of my sight! I told you to wait at Listra-Mouth for Klestreus not to throw your army away with his. By Galzar, I ought to flay you alive! Go, now, while you can!"

"Speak not of your fireseed and your gold," Krastokles told him. "They were the god's gold and fireseed, to be given to you for use in the god's service at my discretion."

"And lost at your indiscretion; you witless fool in a yellow bedgown. Didn't you know a battle when you saw one in front of you? Vyblos, take this fellow you brought, and get you back to your temple with him, and come here again at my bidding or at your peril. Now go!"

He looked at the golden chain in his hand, then tossed it over the head of his cousin Pheblon.

"I still don't thank you for losing me Tarr-Dombra, but that's a handful of dried peas to what that son of a horseleech's daughter's lost me. Now, Galzar help you, you'll have to make an army out of what he's left you."

"My ransom still needs paying," Pheblon reminded him. "Till that's done, I'm still oath-bound."

"So you are. Twenty thousand ounces of silver, do you know where I can find it? I don't."

"I do, Prince," Skranga said. "There should be five times that much in the treasure vault of the temple of Styphon, here."

His horse stumbled, jerking him awake, and he got back onto the road. Behind him clattered fifty-odd men, most more or less wounded, but none seriously. There had been a score on horse-litters or barely able to cling to their mounts, but they had been left at the base hospital in Sevenhills Valley. He couldn't remember how long it had been since he had had his clothes off, or even all his armor. Except for pauses of a quarter-hour now and then, he hadn't been out of the saddle since daybreak, when he had crossed the Athan with the smoke of southern Nostor behind him.

That had been as bad as Phil Sheridan in the Shenandoah, but every time some peasant's thatch blazed up, he knew it was burning holes in Prince Gormoth's morale. He had felt better about it after seeing the mile-wide swath of devastation along the main road in East Hostigos; at Systros, there wasn't a house unburned. It stopped dramatically short at Fitra, and that made him feel best of all.

And the story Harmakros' stragglers had told him—fifteen eight-horse wagons, four tons of fireseed, seven thousand ounces of gold, that was at least one hundred fifty thousand dollars, three hundred new calivers and six hundred pistols; a wagon-load of plate armor. Too bad that archpriest got away, his execution would have been a big public attraction in Hostigos Town.

He had passed prisoners march-

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ing west, mercenaries, under arms and in good spirits, at least one pike or lance in each detachment sporting red and blue colors. Some of them shouted "Down Styphon!" as he rode past. The back road from Fitra to Sevenhills Valley had not been so bad, but now, in what he had formerly known as Nittany Valley, the traffic became heavy again. Militia from Listra-Mouth and Vryllos, marching like regulars, which was what they were, now. Lines of farm wagons, piled with sacks and barrels and furniture that must have come from manor houses. Droves of cattle, and droves of prisoners not in good spirits and not armed, under heavy guard; Nostori headed for labor camps and intensive Styphon-is-a-fake indoctrination. And guns, on four-wheel carts, that he couldn't remember from any Hostigi ordnance inventory.

Hostigos Town was in an all-time record traffic jam. He ran into the mercenary artillery captain, wearing his sword and dagger, with a strip of blue cloth that seemed to have been torn from a bedspread and a red strip from the bottom of a petticoat. He was magnificantly drunk.

"Lord Kalvan!" he shouted. "I saw your guns; they're wonderful! What god taught you that? Can you mount mine that way?"

"I think so. I'll have a talk with you about it tomorrow, if I'm awake then."

Harmakros was on his horse in the square, his rapier drawn, trying to untangle the chaos of wagons and carts and riders. He shouted to him above the din:

"What the Styphon; when did we start using three-star generals for traffic cops around here?"

MP's, of course; how the devil had he forgotten about that. *Memo: Organize, soonest.*

"Just till I can get a detail here. I sent all my own crowd up to the castle with the wagons." He started to say something else, stopped, and asked: "Did anybody tell you about Rylla?"

He went cold under his scalding armor. "Great Draml, no. What about her?" It seemed eternity before Harmakros answered:

"She was hurt; late yesterday, across the river. Her horse threw her, or something; I only know what one of Chartiphon's aides told me. She's at the castle—"

"Thanks; I'll see you later."

He plowed his horse into the crowd. People got out of his way and yelled to those beyond. Outside town, the road was choked with things too big and slow to get out of the way, and mostly he rode in the ditch. The wagons Harmakros had captured were going up to Tarr-Hostigos, huge covered things like Conestogas with the drivers riding the nigh horses. He thought he'd never get past them, there was always another one ahead. Finally, he rode

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through the outer gate of Tarr-Hostigos.

Throwing his reins to somebody, he stumbled up the steps to the keep and through the door. From the Staff Room he heard laughing voices, Ptosphes' among them. For an instant he was horrified, then a little reassured. If Ptosphes could laugh, maybe it wasn't so bad.

He was mobbed as soon as he entered; everybody was shouting his name and thumping him on the back, he was glad for his armor. A goblet of wine was thrust into his hand. Ptosphes, Xentos, Chartiphon, most of the General Staff—And a dozen officers decked with red and blue, whom he had never seen before.

"Kalvan, this is General Klestreus," Ptosphes was saying, to introduce a big man with gray hair and a florid face.

"An honor, General; you fought most brilliantly and valiantly." He'd fought like a damned imbecile, and his army had been chopped to hamburger, but let's be polite. He raised his goblet to the mercenary and drank. It was winter wine, set out in tubs to freeze and the ice thrown off until it was almost as strong as brandy. Maybe sixty proof, the closest they had to spirits here-and-now. It made him feel better, and he drank more.

"Rylla; what happened to her?" he asked her father.

"Why, she broke a leg," Ptosphes began.

That scared him. People had died of broken legs in his former world, when the level of the medical art was at least up to here-and-now. They used to amputate—

"She's all right, Kalvan," Xentos was saying. "None of us would be here if she were in any danger. Brother Mytron is with her. If she's awake, she'll want to see you."

"Then I'll go to her." He finished his wine and put the goblet down; drew off his helmet and coif and put them beside it, stuffed his gloves through his belt. "You'll all excuse me—"

Rylla, whom he had expected to find gasping her last, sat propped against a pile of pillows in bed, smoking a pipe with a cane stem and a silver-inlaid redstone bowl. She wore a loose gown, and her right leg was buckled into a huge contraption of saddle-leather. Mytron, the chubby priest-physician, was with her, as were several of the women who functioned as midwives, herb-boilers, hexers and general nurses. Rylla saw him first; her face lighted like sunrise.

"Hi, Kalvan! Are you all right? When did you get in? How was the battle?"

"Rylla, darling!" The women sprayed away from in front of him like grasshoppers. She flung her arms around his neck as he bent over her; he thought Mytron stepped in to relieve her of the pipe. "What happened to you?"

"You stopped in the Staff Room,"

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she told him, between kisses. "I smell it on you."

"Well, what did happen?"

"Oh, my horse fell on me. We were burning a Nostori village, and he stepped on a hot ember." Yes, just like William the Conqueror. Nantes, 1087, the history professor in the back of his mind reminded him. "He almost threw me, and then fell over something, and down we both went. I had an extra pair of pistols down my boot-tops; I fell on one of them. The horse broke a leg, too, and they shot him."

"How is she, Mytron?"

"Nothing to worry about, Lord Kalvan! It's a beautiful fracture. A priest of Galzar set it—"

"And gave me a Styphon's own lump on the head, too. And now, it'll be a couple of moons till we can have a wedding."

"Why, we could have it now—"

"I will not be married in my bedroom. I will be married in the temple, and I won't be on crutches."

"It's your wedding, Princess." He hoped that the war with Sask everybody expected would be out of the way before she was back in the saddle. "Somebody," he said over his shoulder, "go and have a hot bath brought to my room, and tell me when it's ready. I must stink to the very throne of Dralm."

"I was wondering when you'd mention that, darling."

Sesklos, Supreme Priest and Styphon's Voice, rested his elbows on the table and palmed his smarting eyes. Around him pens scratched and parchments rustled and tablets clattered. He longed for the cool quiet of the Innermost Circle, but there was so much to do.

The letter from the Archpriest of the Great Temple of Hos-Agrys lay before him. News of the defeat of Prince Gormoth's armies was spreading, and with it rumors that Ptosphes of Hostigos was making fireseed for himself. Agents-inquisitory reported that the ingredients and even the proportions and processes were being bandied in the taverns. To kill everyone who knew the secret was quite out of the question; even a pestilence couldn't do that. And how to check the spread of the secret without further divulging it?

He opened his eyes. Admit it; better that than deny it and later be proven liars. Let everyone, even the lay guards, know the full secret, but, for believers, insist that special prayers and rites, which only yellow-robe priests could perform, were necessary.

But why? Soon it would be known to all that fireseed made by unconsecrated hands would fire as well.

Well, there were malignant demons of the netherworld. Everybody knew that. He smiled, imagining them thronging about, scrawny bodies, bat wings, bristling beards, clawed and fanged. In fireseed there were many of them, and only the prayers of anointed priests of

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Styphon could slay them. If this were not done, as soon as the fireseed was exploded, they would be set free into the world of men, to work manifold evils and frights. And, of course, the curse of Styphon was upon all who made fireseed unconsecrated.

But Ptosphes had made fireseed and had not been smitten, and he had pillaged a temple-farm and massacred the priests, and after that he had defeated the armies of Prince Gormoth, who marched with Styphon's blessing. How about that, now?

But wait! Gormoth was no better than Ptosphes. He had made fireseed himself, both Krastokles and Vyblos were sure of it, and he had blasphemed Styphon, and despitefully used a holy archpriest, and forced a hundred thousand ounces of silver from the Nostor temple, at as close pistol-point as didn't matter. To be sure, most of that had been after the battle, but who outside Nostor would know that? Gormoth had suffered defeat for his sins.

He was smiling happily, now. Of course, Hostigos must be utterly destroyed and ruined, and all in it put to the sword; the world must see, once and for all, what befell a land that turned its back on Styphon. Sarrask of Sask would have to do that; Gormoth couldn't, even if he could be trusted to. Sarrask, and Balthar, Prince of Beshta; Sarrask had been seeking a Beshtan alliance, and now was offering his daughter, Amnita, in marriage to Prince Balthar's younger brother, Balthames. An idea began to seep up into his mind.

Balthames wanted to be a Prince, too. It needed only a poisoned cup or a hired dagger to make him Prince of Beshta, and Balthar knew it. He wanted Balthames and his ambitions removed; should have had him killed long ago. Now, suppose Balthames married this wench of Sarrask's; suppose Sarrask gave up a little corner of Sask, and Balthar a little corner of Beshta, both adjoining Hostigos. Call it the Princedom of Sashta. To it could be added all western Hostigos south of the mountains; why, that would be a nice little princedom for any young couple. He smiled benevolently. And the father of the bride and the brother of the groom could recompense themselves, respectively, with the Listra Valley, rich in iron, and East Hostigos.

That should be done immediately, before winter set it; then, in the spring, Sarrask, Balthames and Balthar could hurl their combined armies out of conquered Hostigos into Nostor. He'd send out another archpriest of Styphon's House Upon Earth . . . let's see who that should be . . . to Sask, to make arrangements—with lavish gifts of money and fireseed for Sarrask and Balthar. And this time, make sure the treasures of Styphon's House did not fall into the hands of the infidel. ■

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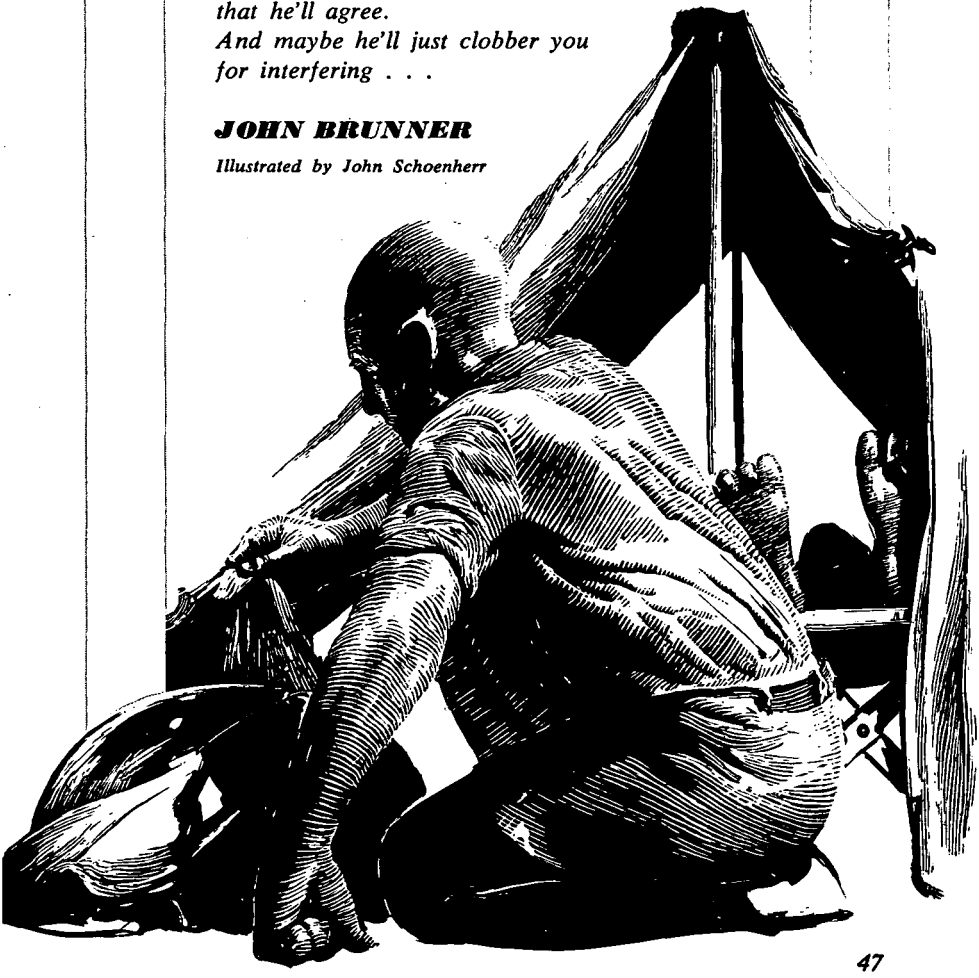
Even Chance

If you do a man
what you consider a favor—
there is perhaps an even chance
that he'll agree.
And maybe he'll just clobber you
for interfering . . .

JOHN BRUNNER

Illustrated by John Schoenherr



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Some of the fiercest fighting of World War II ebbed and flowed for months on either side of the territory of the Kalangs, but there was only one occasion on which the larger sweep of world events intruded into that inaccessible and hilly region of northern Burma to which they laid claim.

This intrusion began when a photo-reconnaissance plane on its way back from a risky, but crucial, mission suffered engine failure not far away. The pilot saw his navigator bail out safely, and shortly afterwards did the same himself. He wound up hanging from a high tree-branch in clear sight of a Kalang hunting party, with sprains, scratches and bruises, but otherwise unharmed.

What little the hunters knew about either the white or the yellow man inclined them to distrust any stranger. However, the manner of the pilot's arrival—on white wings from the sky—was sufficiently impressive to keep them from acting on their first impulse and killing him out of hand. Instead, they escorted him at spear-point back to their village, where—after duly consulting the omens—the chief sheltered him, fed him, and eased his pain with strong bowls of *ku*, which passes among the Kalangs for beer.

The plane, naturally, and the cameras it carried were completely lost; however, the nature of the mission had been important enough for a search party to go looking for survivors, who might have verbal information. The pilot was found, feverish but alive. The officer in charge very properly gave the tribe enormous gifts of tea, tobacco and salt.

When the strangers had gone, the chief fingered the beautiful steel of the machete which he had exacted as his personal share of the reward, and issued orders that anyone else who came floating down from the sky should be treated in the same fashion.

Tambah, of course, had not even been born at the time, but he had had this information as part of a long, complex, didactory tale his father told. He had seen the machete, a little rusted but still a thing to marvel at; he had seen the tattered ceremonial robe the chief had caused to be made from the parachute. To bring the now starving and depressed Kalangs such riches as the tale described—that had long been Tambah's most powerful ambition.

Even more powerful as a driving force was his present anger. The chief had twice passed him over for the manhood ritual, with contemptuous remarks about his small size and general incompetence. And that was why he had kept this great discovery to himself.

Not only that. He had set off to share it with other people—with strangers—before telling his own family. It was a fearful risk, and even though he knew the chance of

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anyone following him was minimal —since after much debate about the unprecedented signs in the sky the whole tribe had settled down to a god-propitiating rite scheduled to last three full days—he could not keep from glancing over his shoulder every few minutes. He was tired and his feet were abominably sore; his burden grew heavier with each step. Yet he kept going, lured on by the dream of bringing the flying people to claim their own and thus being the instrument of gaining new riches for the Kalangs.

It was early morning when he came out of the thick forest and paused on an outcrop of rock, to see before him a village of strange conical huts. For several seconds he did not take in their true nature; then he saw a man moving about among them, and realized he had reached his goal. He ought, he knew, to be cautious, but somehow the reason would not come clear in his mind. His thinking was blurred; the pain from his feet was dull and unreal, and his mouth was very dry.

No—not completely dry. He sucked automatically at his teeth, put up the back of the hand which was not steadying his load, and wiped across his lips. When he took the hand away, there was a little smear of blood on the skin.

But his exhaustion forbade him to think even about that. He stumbled down to the village of the flying people, trying to shout the news he brought.

Jan Bilay walked around the jeep one final time to make sure the cases of fragile ampoules were securely lashed, rubbed a few flakes of mud off the World Health Organization insignia on the driver's door, and sighed.

"Seems O.K.," he muttered. "Think you'll find them today?"

"I guess we have a better chance than yesterday," Dinah Ashman said, glancing up from her job of counting hypodermic needles in the back of the vehicle. "We know we're already into Kalang territory now—we found that abandoned village, for instance."

"You're still sure it was abandoned?" Carlos countered from behind the wheel.

"We've been over that," Dinah snapped. "Yes, I am sure! After all, it's a common enough pattern where you hail from—working the cleared ground to death, then moving the whole tribe on."

Carlos shrugged. After a moment's wait to see if he would speak again, Jan ventured, "Look, I know this isn't my specialty, but— Consider: we know they're shy, and they've evaded contact with the outside world right up till the present. Could they not be hiding from us? Perhaps . . . oh, perhaps they took that meteor fall the other night as a warning from heaven against our arrival."

"Then we'll just have to persuade them we mean no harm," Dinah Ashman answered. "They don't

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keep to themselves completely—if they did, we could let them be. But as long as they're a reservoir for yaws infection, any contact at all with anyone around is a nuisance."

"You take it too lightly," Ba Thway objected from his seat beside the driver. "I'm the one who has to do the persuading you speak of so glibly. For a country with most of the European ethnic groups in it, America breeds few linguists."

"Can we save the argument till we're on the road?" Carlos grunted.

"Road!" Jan said sourly. "I tell you, I'll spend the day praying for you to find your way back to camp." But he withdrew the sunburned arm he had been leaning on the jeep door.

He watched the jeep bump over the rough ground till it was gone from sight. If they did find these elusive Kalangs, he promised himself, he was going to take a couple of days off from his own work and help out with the injections. When he first set out with the WHO team, he had felt rather sorry for them in their repetitive work: finding villages, winning the confidence of the people, then vaccinating and inoculating on a production-line basis. He had been sure his own study of the local disease-vector pattern among water-breeding insects was much more varied and interesting.

But now it entailed so much of this being left alone all day in the camp, he was getting distinctly bored.

And jumpy, too, he told himself when—some half-hour or so later—he started and almost spilled a jar of distilled water on seeing a movement out of the corner of his eye. A second look showed nothing; nonetheless, a bit shamefacedly, he fetched the expedition's only weapon, an elephant gun, and doggedly set off to inspect the site of the disturbance.

Its cause came to meet him: a naked brown boy, carrying something large and shiny on his shoulder, dragging his feet as though intensely weary. At first he did not see Jan; when he did, he made to remove the shiny thing from his shoulder and hold it out like an offering. The weight was too great. It slipped from his grasp and struck the ground with a metallic ring—and a moment later the boy keeled over in a dead faint.

Blazes! Jan stood uncertainly, reviewing the half-dozen phrases he knew in Burmese—which almost certainly wasn't spoken hereabouts—and wishing the others were here. He had no knowledge of medicine beyond first-aid, and this boy was evidently ill. He was covered with weals and scratches; his feet were cut and thorn-pricked; his pulse was going like a hammer. Also a trickle of blood oozed from his mouth, but Jan discounted this, assigning it to his having fallen face-foremost to the ground and cut his lip.

Exhaustion combined with heat-

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stroke was the obvious diagnosis. Jan picked up the limp body and carried it to the camp-bed in the nearest tent—Carlos'. He attended to the abrasions and picked out the worst of the thorns, then wiped away the blood on the boy's chin.

That was when he began to wonder. The blood returned. On pushing back the lower lip, he saw that the gums themselves were oozing a slow red stream. He gazed at the sight thoughtfully, presumed pyorrhea in default of any other guess, and wiped the inside of the mouth with a solution of antiseptic. The boy didn't stir. He was in complete coma now.

What could have reduced him to this state? Something to do with the object he'd been carrying, still on the ground outside? Jan went and examined it. It was a very strange thing to find in this remote corner of the world.

It was metal. By its lightness, he hazarded that it was an aluminum-magnesium alloy. It had been formed to a careful curve, but one edge was jagged, as though an explosion had broken it away from whatever it belonged to. One whole side was discolored—seemingly, from the effect of intense heat.

Light though it was in relation to its size, he estimated it would still tip the scale at around thirty pounds. Quite a load for a scrawny youth to tote through dense forest!

The obvious hypothesis was that there had been a plane-crash, and the boy wanted to report it. And there was precisely nothing Jan could do. He didn't speak the boy's language; anyhow, he couldn't set out across this sort of country on foot even with the boy to guide him —and the boy was in no fit state to move.

He tried to face the logic of this, and struggled to get on with his day's work, but concentration was impossible. Every five or ten minutes he found he was peering into the tent where the boy lay unconscious. He knew this was pointless, yet something nagging at the edge of his mind drew him back again and again.

Deliberately, he refrained for one full hour from going to see the same sight. When the hour was up, he went back with hurried paces.

The boy had turned over, without waking. Jan's first horrified impression was that he had thrown up black vomit, and visions of cholera filled his mind. Then the moment of gestalt seeing passed, and he realized the dark stain on the pillow was a patch of hair which had come away from the scalp.

In the same moment he realized what the nagging oddness about the tent had been, when he kept returning and returning earlier in the day.

This tent was Carlos'. As well as being the expedition's chief driver and mechanic, he was in charge of their fall-out monitoring kit. Every evening he filled out a fresh line on

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a printed form, and each completed form was sent to the UN's commission on nuclear weapons testing. The latest of the test ban agreements was currently in force, but at any moment some new country might make the technical breakthrough and achieve the modern national status symbol.

And right now, muffled by a covering of odds and ends under the bed, the Geiger counter in Carlos' kit was chuckling to itself.

Jan dug it out frantically. He swung the pickup, and as it traversed the limp body of the boy it rose to a scream before dropping back to a lower frequency with a change of scale; it was being triggered faster than the spring could reset it at normal levels.

Sweating, moving with a kind of controlled panic, Jan went outside. He improvised tongs from a couple of long sticks, and with them carried the piece of metal well away from the camp. He dropped it into a niche between two boulders, which ought to afford some measure of shielding, and tossed the sticks down after it.

This was going to be hard on the boy, he reflected as he set a pan of water on the fire and hunted up a cake of carbolic soap. But it would have to be done, hopeless though it probably was by now. And afterwards he'd have to scrub himself, pare his nails, change all his clothes.

Frantically he demanded of the unanswering air how a Burmese savage had come to suffer the worst case of radiation sickness he had ever seen.

On their return that night—despondent at having failed to locate the still-elusive Kalang tribe—the others simply declined to believe him. Not until Carlos had checked the lump of metal with the counter were they convinced. And then they were as bewildered as Jan.

They could only hope that the boy might speak before he died; to that end, they checked his blood type and discovered by a fortunate coincidence that it matched Ba Thway's. Dinah took charge of an emergency transfusion for him, and Jan and Carlos went out to inspect —very cautiously—the mysterious chunk of metal.

"What do you make of it?" Jan demanded.

Carlos hesitated. At last he said, "Frankly, it makes me wonder if we really did see a meteor the other night."

Jan pursed his lips. "I . . . wonder! I'm ceratin it couldn't have been an aircraft on fire, but—" He saw it in memory, as vivid as in present time: a huge scything streak of flame across the night, followed by a roaring noise. "A rocket? A missile with a nuclear warhead?"

"That I doubt," Carlos muttered. "To pick up a charge like this, a fragment of metal would have had to be very close indeed to a fast reaction, and in a warhead you don't

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have the reaction unless you mean business. But an atomic engine, now —that's something altogether different."

"Are you serious?"

Carlos shook his head. "I don't know. But there has been talk for a long while of a breakthrough in propulsive atomics. Whatever happens, though, one thing is beyond doubt. We shall have to forget about these Kalangs and get to the site of the crash as fast as we can. In fact, I guess I'd better try and raise Rangoon by radio at once."

The officials in Rangoon were likewise skeptical, all the more so because even the transfusion failed to revive the boy, and the information the WHO team could pass was sketchy. A couple of hours later, a reply came through: they were to remain with the boy, and in the morning an aerial search would be made of the locality.

None of the team got much sleep that night, tired though they were; Carlos' idea that a nuclear-driven rocket might have crashed hereabouts was far too uncomfortably convincing. They took turns watching the boy's bed, and the rest of the time argued groundless theories by the fire.

They half-expected that Rangoon had made the promise of a search in order to shut them up for the night. It was with acute relief that Jan heard the first plane shortly after sunrise. His call brought the others running to stand with him staring up at the sky.

"High-level photographic plane," Carlos said at length. "A fat lot of use that'll be in country like this. How about some helicopters, for heaven's sake?"

"They're slower, aren't they?" Ba Thway suggested. "Can't get here so quickly."

"I know that!" flared Carlos, rounding on the little Burmese. For a moment Jan feared that overtiredness might be going to lead to a shouting match; then Dinah interrupted from the door of the tent behind.

"He's got his eyes open! Ba, come quickly!"

It was immensely difficult for Ba to piece together the boy's words. The local dialect—which they were shaken to find was the Kalang tongue, that of the very tribe they were seeking—was only a cousin of the languages he had studied, and the boy was moving in and out of delirium most of the time. They learned that his name was Tambah, and that he was angry about being passed over for full adult status. They learned that there was some legend about a man from the sky, and that he had hoped to bring rich rewards to the Kalangs for notifying the flying people about the crash.

But at this point Ba began to doubt his own interpretations. For Tambah seemed to be implying that there was a man in the crashed air-

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craft, and this on the face of it was ridiculous. Those countries sufficiently advanced to have a nuclear drive were also sufficiently advanced—and heedful of human life—to automate the control system. This surely must be wishful thinking on Tambah's part; he must by now be so confused as to mix the traditional tale of a man from the sky with what he had actually seen.

He lay there, rolling his eyes in fright whenever he was aware enough of his surroundings to react to them, and moaning his garbled pleas about a reward.

Ba gave him a reassuring pat on the chest and looked at Dinah.

"How long will he last?" he whispered—ridiculously, for the boy could not possibly understand English.

"If he can be flown out to a hospital, a day or two. We'd have needed all sorts of things we can't give him—like intestinal detergents—if we were to save him. Now I think he's past hope."

"We'll try and get a description of the crash site," Ba muttered, and gestured for the others to leave, for they were distracting him.

This was the substance of the report they gave to an officer of the Burmese Air Force who dropped in by helicopter about noon, ordered to verify the existence of the mysterious piece of radioactive metal because so far the photographic plane hadn't spotted any signs of the crash. He also wanted more precise details of where it was supposed to have happened, and was politely contemptuous when he learned that the team had been tracking the Kalangs for weeks without success, yet the crash must have occurred in Kalang territory.

The boy fainted again.

From then on, through the long afternoon, they were never out of earshot of the helicopters' drone. Someone at high level must be taking this seriously to put as many as eight of the whirlybirds on the job. Jan said as much to Carlos.

"I guess it might prove the opposite," Carlos said morosely.

"What do you mean?"

"Might just be the Burmese putting up a good front. After all, it doesn't have to be a chunk off an atomic engine over there." The Mexican gestured. "Could equally well be a bit from a nuclear device that fizzled like a wet firework. Though if it is, I don't know how a naked savage got close enough to pick it up."

It was almost sunset when the 'copters came back. There had been no news for two hours, as though someone had ordered radio silence to be imposed—for up till then they had caught odd snatches of chat between the searching planes. One of the 'copters had a big dark cradle slung beneath its undercarriage legs, and the others swarmed around it as though flying escort duty.

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The team stood by their tents, staring up in puzzlement and wondering what the load might be.

Then the trailing 'copter detached itself and came roaring to a landing in the same place as before; the same officer got out, very pale and drawn. At first he seemed not to know what to say; then he collected himself and stared at them as though at ghosts.

"I . . . I have orders for you," he forced out. "You are to return at once to your base. You are not to use your radio under any circumstances, and you are not to tell anyone why you are going back without finishing your work."

"What?" As one, all the members of the team stepped forward.

"I—" The officer wiped his sweating face. "Oh, I'm going to tell you before they forbid me to! Listen, we found the plane that crashed, scattered over half a mile of jungle. We . . . we found the pilot, too."

"So Tambah wasn't delirious when he said there was a man in that thing," Ba Thway exclaimed.

"No." The officer eyed them strangely. "No, he was wrong to say there was a man in it."

Jan was the only one of those listening who got the point. He felt all the blood drain from his face.

In times to come

Next month's issue brings the beginning of a two-part serial by Mack Reynolds, titled "Beehive."

You regular readers may remember the yarn some while back —March, 1961—in which a young agent for the United Planets undercover agency is sent out trying to find "Tommy Paine." Who turns out to be his own agency, upsetting happy worlds, because of the half-burned corpse of a rabbity little alien found in a derelict, violently smashed warship. Somebody else had clobbered the rabbity creature—despite the fact that the rabbit's ship had weapons the best human weapons experts couldn't even guess at.

"Beehive" takes up where that left off. With the added little item that the little oxygen breather rabbity alien's home planet, it turns out, now has an ammonia-methane-hydrogen atmosphere. Whoever clobbered the little aliens—really clobbered them. Somebody somewhere has a most devastatingly nasty temper . . .

Problem: Locate them before they locate you. THE EDITOR

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"You mean the pilot *isn't* a man?" he whispered.

"That's exactly what I mean," the officer said. His eyes were on the dwindling silhouettes of the other 'copters. "They're on the way to a hospital now, to see if we can save him . . . I mean, see if we can save *it*."

"An atomic rocket," Carlos muttered. "With a creature from another planet in it— Oh, this is fantastic!"

"I've seen it," the officer said. "And . . . and that isn't right, either. It's in pieces, but you can see for certain it isn't anything so straightforward as a rocket. It's . . . it's something different."

"But with an atomic drive?" Carlos pressed.

The officer swallowed enormously. He said, "I don't think so. We had Geiger counters, and we surveyed the outside of the hull, then what we could get at of the inside. And the radiation is all on the outside."

They waited. He hadn't finished confiding his terrible suspicions to them. At last, the decision to continue causing beads of sweat to cover his face, he let the words come out in a rush, his tone mirroring his deep emotion.

"No, you see . . . we found what must be the control cabin, and then the engine room, and then what must be . . . what has to be . . . the guns."

"Guns?" Jan took half a pace forward, but the officer didn't notice, didn't interrupt the flow of his soft fearful words.

"And all over one side of the wreckage, splashes of molten metal and this tremendous radiation reading— I don't think the ship crashed here by accident. I think—"

Now he did pause, and looked away from the vanishing helicopters to the darkening sky, where the first stars were springing into view.

"I think, somewhere up there, there's a war going on. I think that ship was *shot down*. And what I want to know is this—who's going to come looking for the survivors?"

The navigator of the reconnaissance plane bailed out much earlier than the pilot, and landed a good twenty miles away. He reached the ground safely, in full view of a village belonging to a people called the Ipoh, who knew almost as little as the Kalangs about the progress of World War II.

They were, however, a friendly and hospitable people, and greatly impressed by the manner of this man's arrival, on white wings from the sky. They gave him food and shelter, and when a search party came to investigate from the nearest lines—where they had seen the parachute open—the navigator was found alive and well. The officer in charge very properly razed the village to the ground and shot the chief for collaborating with the enemy. ■

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PROBLEM IN THERMODYNAMICS

Watching some small birds through the dining room window last January brought an interesting problem in heat-transfer to mind.

Given a temperature of 2°F. above zero, a wind of about 15-20 M.P.H., and an ice coating—due to a previous evening sleet storm—on every branch . . . how does a sparrow, Tufted Titmouse, Junco, or Chickadee keep its less-than-toothpick size toes from freezing?

The bird's body has feathers for thermal insulation; agreed that feathers are even more efficient as thermal insulators than hair—the toes and legs have only scales, which aren't insulating.

Yet these birds remain functional despite as much as 50-60 degrees of frost!

Those toes are working far down in the square-cube law region—lots of area in proportion to volume. They have to have complex structures of bones, tendons, skin, and nerves; that doesn't leave much cross-sectional area for a two-way blood flow to carry heat into the tissues, even allowing the small body can afford the heat-loss.

And the toes must not freeze, or they'd lose flexibility and the bird would be unable to escape.

Anybody got answers on what sort of anti-freeze system Titmice and Chickadees use? A Chickadee's idea of migrating south for the winter seems to be to move into Southern Vermont, or northern New Jersey.

If anyone has an answer to that, it might be useful to men in the Arctic . . . or on Jupiter's moons!

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Ugh, the Caveman
had terrible problems.
Cave bears—bitter cold—
lack of game—
We've solved all those . . .

A long way to go

ROBERT CONQUEST

Kelly Freas

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Jexin spoke again: "You are intelligent and resilient, Mr. Randall. You have understood that you are in what is, to you, the future. A few simple points were sufficient for that. You made your hand transparent for a few minutes by holding it in the circuit. You saw the *mala*. In fact you didn't even bother to try the antigravity."

That must have been the third thing mentioned in the note beside his bed, which would have come into action if he had stood on the square in the corner. No, he had indeed been convinced in a hurry and had run down expecting to see wonders. Instead here he was eating bacon and eggs on the terrace of the building—a pastel concrete horror of the nineteen-fifties. The others at the terrace table, Jexin, the blond girl Sara, and the silent young man were all three ordinary fair types, lightly dressed in what seemed like conservative beachwear.

The view in front was simply of palm trees, a beach, a coral reef, a cobalt sea.

Randall wanted to ask where the *mala*—a furry little beast like an overgrown starfish with ears—came from. But there were so many questions and Jexin was evidently determined to get home a point he regarded as important:

"To be in the future—that is the smallest thing. The essential is: you have come forward *more than five hundred years*. The simple tricks in your bedroom could have been shown you centuries ago."

Randall finished the excellent coffee and asked: "How did you get me here? You have time travel?"

"Not exactly. You were . . . well, it's hard to express it to you . . . taken out of ordinary space, into stasis, until we returned you to normality a few weeks ago. We set the fields up on the site of some old telephone booths in London. The archaeologists were very helpful. It's still a bit radioactive."

"Was London atom-bombed then?"

"No. Very few cities were, in fact. Just evacuated under threat

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and then sown with radioactive dust. And by the second part of the war they'd discovered a defense—the hyperson-resonance screen."

"What was that?"

"You see part of our difficulty? You were an educated man. You knew what to expect within the limits of further developments in your then sciences. Think of a man from 1890—you could explain the airplane to him, but the whole science behind atomic power would be absolutely missing. And by mid-century things were developing twice as quickly. It's ridiculously conservative to imagine only what your writers of fantasy could predict."

He paused. The soft rasp of cicadas filled the brief silence.

"Well, I can see that," said Randall.

"By the end of your century the war was long over, there was world federation, the planets had been reached, cities had been abandoned, production was done entirely in automatic factories. Almost everything you think of as the future had already happened! After that psychology became a science. They had to solve the problem of freedom: What happens to it when educational techniques can completely form a man's character?"

"That sounds very tricky."

"Yes, it took a culture far in advance of yours a whole generation to settle. And that was five hundred years ago. A man from 1400 A.D. taken to your own time—even a very intelligent one . . .Chaucer, say—would be baffled by everything. He would be shocked by every social custom. Even you, from a partly scientific age, an adaptable type, would die like an old Polynesian simply of social and intellectual shock if you were exposed straight to our culture. We weren't able to let the others we drew from your time become conscious at all. They had to be adapted—psychologically reconstructed—at once."

From the hotel window came curious music, vaguely reminding Randall of records of Indonesian rhythms. The blond Sara smiled at him and said, "We thought you'd like the old stuff. Even the music is nearly five hundred years old, I think about your own time. It's done by Lanta: she's a wonderful creature, purple—" She caught Jexin's eye and was silent. Words Randall knew, in a high sweet voice, came clearly to the music:

"The first of all the tribe lay there,
And did such pleasure take
—She who had brought great Hector down
And put all Troy to wreck—
That she cried into this ear
Strike me if I shriek."

He breathed out slowly, the smoke of his cigarette unwinding in the light breeze. He did indeed like the old verses and the continuity of culture this seemed to represent. Or was this just a silly antiquarianism, only done to please him?

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What did they want with him anyhow? Was this merely a scientific project, an experiment?

He shrugged and said to Sara: "Well, I'm glad they abolished war!"

But it was Jexin who answered: "Abolished war? No, there were later wars. The photon drive was perfected in 2007. It took twelve years to reach Procyon. (Nowadays we do it without a time component, by space warp.) During the period of establishing friendly relations with other systems, a backward species got hold of too much advanced science. There was a war. H-bombs? This was fought with star-busters!"

"Good God! I hope you solved that one?"

"Yes. There really can be no more war since they developed the frustrator, three centuries ago. Any undesired energies, however great, can be put into stasis—the method we used to bring you forward in time, as a matter of fact."

Sara and the young man got up with an air of going back to work, smiled and walked towards the old hotel. Randall said: "I'd like to look around."

Jexin rose. "Certainly. We'll go up the hill."

It was very cool in the hotel's shadow. Then they were out on a path wound through a group of high palm trees, rooted in crumbly, sandy soil.

"Anyhow, I'm glad they settled the war. The H-bomb was nothing to sniff at—even with your screen."

Jexin smiled: "It wouldn't even get through my weatherproof." He pressed at the strap on his wrist and a slight shimmer appeared in the air an inch or two away from his skin.

The path was now uphill, among smooth runneled rock and umbrella pines.

Randall asked a question which had been bothering him: "Do you have telepathy?"

"Not in the sense you mean. That turned out to be a red herring. There are mechanical methods of reading, or rather interpreting, minds."

"Mechanical?"

"Yes, based on something like your machines for recording the electrical rhythms of the brain."

"Oh, yes, I know about them."

A lizard flickered over the hot stone in front of them.

"Well, on a greatly refined and complicated scale. A person is recorded for weeks and answers questions at the same time, until they can correlate the detail of his rhythms with the content of his thought. After that you can tell both his verbal and his emotional states, by reading the rhythms. Simple."

"Since it's something I can more or less understand, I take it it's a pretty old development?" Randall spoke sardonically, but not bitterly so. They didn't seem to treat his ig-

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norance as a sign of backwardness. Moreover, they appeared to regard him—or perhaps their work with him—as in some way important.

"Oh yes—centuries."

They were at the top, an open space of harsh grass. A mile or so away in each direction lay the smooth sea. It was an island. The beach stretched for several hundred yards near the hotel, ending on the left in a little creek. On the other side, partly concealed by outcrops of stone, were half-a-dozen darkish structures.

Jexin followed his gaze. "We're living down there—it's more convenient."

Randall turned and looked at him. "Where are we?"

"In the northern Caribbean—we can't let you out into the world yet. Meanwhile perhaps you would like to look round by yourself?"

"Yes", said Randall abstractedly.

"Anywhere, but we'd rather you didn't go into the hotel basement—it's a sort of control room."

"And I'm just a blasted experimental white mouse!" said Randall in sudden annoyance. He turned away rather sharply and began to walk down the other side of the hill.

Jexin called after him as calmly as ever: "Yes, we know we've no right to. But I assure you—" then he was out of hearing.

As Randall strode on the irritation faded. He did not really doubt Jexin. It was just that he didn't like the feeling of being even temporarily a helpless infant or patient. But after all he had been both in the past and got over it!

The path curved back, along low bluffs. Beyond them lay, in a little hollow, the structures he had seen from above—dark hemispheres about fifteen feet high.

He walked forward and touched one. His finger went into it, remaining partly visible, until it was gradually halted. But there was no rubbery feeling, no back pressure. He withdrew the finger and looked very closely at the surface. He seemed to detect a slight scintillation running up and down, like a flicker just too rapid to be properly seen.

There was no apparent entrance to any of the huts, and he went on towards the beach, wondering why they had kept everything else on the island—except his "proofs" indeed—so carefully timeless, but left these obviously non-twentieth-century artifacts.

Perhaps it was some psychological detail in creating the atmosphere for his education.

In the late afternoon he lay on the beach alone, sunbathing. The faintest movement of air tempered the clear heat.

He had now, he felt, seen everything on the island. And there seemed little prospect of further travel at present. He had not yet learned much.

Still, all the strange impressions

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had left him rather exhausted. As he lay in the calm, golden warmth, with his eyes shut, his life seemed to slow down, and memories of his own century came welling up from unsuspected depths, vague and formless, yet glowing with effect.

And now the music started again from the direction of the hotel—a slow, intricate beat. Then, quite clearly as the gentle breeze shifted slightly, words, from the same old writer:

"I have old women's secrets now
That had those of the young;
Madge tells me what I dared not think
When my blood was strong,
And what had drowned a lover once
Sounds like an old song."

The vague longing broke over him like a wave, sharp, clear and overwhelming. Yet, as he thought to himself *"strong poets, be with me now,"* it became—not weaker but more supportable, borne up on the framework of the firm verses.

Gradually calm returned. A full calm, in which he felt able to accept his position, his unbelievable isolation, not just in the superficial boldness of his adaptable outer self, but in depth, throughout his heart.

A step crushing the sand beside him made him look up.

There stood a girl. It was not the blonde of the morning, but another with heavy bronze hair and a dark golden skin.

She might have been selected by a conscientious lexicographer to illustrate such adjectives as "breathtaking," "provocative," "delightful." Her features were—a Swedish-Hawaiian hybrid perhaps?

Such, at least, were Randall's first coherent thoughts as he struggled up to a sitting position. The girl, evidently pleased at the effect, leaned forward and said, "I ran down to see you as soon as I came off duty. I'm Tay. Isn't it a trial to be stuck in a strange culture? I was once attached to a mission on Vega II. The light's blue. And then, the Vegans —they *slither* so!"

With one fluent movement she lay down on the sand beside him.

Randall asked: "Why are you so different from the others?"

"Why aren't *I* like the others?" The look of surprise melted instantaneously into a laugh, "You mean why are they so different from *me*. Those fair types are very rare. I believe they chose them to make you feel at home. Except Jexin, of course, who was in it from the start."

"How about you?"

"Oh, I saw you when they first got you, and decided to join." She smiled in an intimate way which irritated him as much as it attracted him.

"You've been held in unconsciousness for nearly a month, you know, and that gave me time to make arrangements and learn the old language." He lay back interested and content.

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Sunset doused the glitter of sand and wave.

On the terrace it rapidly became too dark to read the allegedly simple book Jexin had given him: a primer on psycho-history, in the "old language." Education looked like a lengthy business.

As the stars came sharply out he leaned back and looked up to see which were missing. The only constellation he knew was the Great Bear, which was fortunately in sight on the northern horizon. And, yes, the top right-hand corner of the rhomboid was gone. Some bomb!

As he looked, a golden star, far brighter than any he remembered, moved swiftly into his field of vision and swept smoothly westwards.

"Space station," he said, after a moment. Tay's voice behind him said, "Yes, there are still a few of them up there. They left them because they look so pretty. There's a blue one too, but it's in fixed orbit above Malaya."

He turned and she was standing there, smiling and arrogant. She went on, "Let's go for a row. There's a boat in the creek."

But they walked down towards the "huts."

"Have you been inside?"

"No."

An opening dilated in the surface of the dome, and they went in.

They sat on a long couch. What had happened to his tongue, usually so fluent on these occasions? But at least he could kiss her.

It was one of those kisses which seem to reverse the flow of time, and turn space into a single warm, dark fathom.

She leaned back, gazing up at his face. After a minute she said, "You certainly look luscious—I can't do anything now, but wait till you are generally released." And she made a movement, a gesture, so coarse that he was on his feet and through the opening, trembling, before he had time to think or decide.

He found himself walking back to his room, becoming calmer with each step.

Anyhow it had been an exhausting day. He undressed quickly and got into bed and put the light out.

Did she do that on purpose? Was it to test him in some way?

A wave of modesty, as deep as the earlier certainty, swept over him. How could he have imagined that she'd just liked his looks? His face burned with shame. Probably the opposite had happened—they had cast about for the type who would have the deepest effect on him according to their psychological machines. And that accounted for her late appearance.

That must be true. Yet experience compelled belief in her. His head whirled.

He found himself wishing he were back in the twentieth century.

He switched on the light and sat

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up, meaning to go to the window. But then he noticed a button near the head of the bed, labeled "Deep sleep in two minutes." He pressed it and lay back into a growing calm and a consoling thought, combining satisfaction with modest realism—perhaps she *had* fallen, not indeed for his looks but for some sort of glamour attached to his age. And he *had* felt that overpowering mutual certainty. He knew he couldn't be wrong . . .

But he dreamed badly of that obscenity.

When he awoke he knew at once where he was. The events of the last day were burned as deeply into him as all his previous life.

He thought again of Tay's action.

A new idea occurred to him. Even if it had been a test, it might not have been entirely gratuitous. Perhaps her behavior had been quite customary. And it didn't cancel the sweetness and charm.

It was easy to accept this intellectually. But he wondered how his emotions would let him behave when he saw her.

Another thing struck him. Tay had said he had been unconscious a month. Jexin had told him that any mechanical thought-interpretation needed a few weeks' tests to get it set up for action. Presumably the "control room" had been registering his mind's activities—and his heart's—since then.

Enough clues had been given him to guess this for himself. Had that, too, been planned?

Their motives were beyond him.

He looked out of the window, and, to his relief, saw only Jexin at the table.

A few minutes later he was eating the second breakfast since his revival.

But Jexin was saying: "A decision has been reached in your case: you will have to be adapted. I'm sorry. It had been hoped that you could come to us fresh." He paused. "You'll be no worse off, really. Everything before will be like a vague dream."

"I suppose I failed the test last night?"

"Test?" asked Jexin. "Oh no, that was just a detail—it's difficulties outside." He pointed vaguely over the blue water, now swaying in a light swell.

There seemed nothing more to say. Everything that had happened was as incomprehensible as ever.

But Randall at least knew how to take a disappointment. "Oh well," he said, "it won't be too bad. Perpetual peace, brotherhood, freedom, plenty. Your world has solved all the problems we could even imagine."

"Yes." Over Jexin's hitherto calm features spread a look of appalling strain and apprehension.

"Yes," he repeated, "but we have our own. . . ." ■

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some preliminary notes on FASEG*

This is a very *special feature. Almost special enough to reactivate the old "Probability Zero" department!*

LAURENCE M. JANIFER and FREDERICK W. KANTOR

One of the problems involved in doing basic research on the properties of spirits is that spirits, in the great majority of cases, are incoherent. This incoherency may be compared to the incoherency of light emitted from a normal light bulb. One of the most difficult technological problems to be solved, therefore, before further experiments might be performed was the problem of producing spirits which were coherent—for example, the comparatively simple area of work in which this research group has become interested: producing coherent fairy godmothers.

References in the literature, in most cases literature of a certain antiquity and standing, points out that the natural pumpkin is, in fact, a ground state of many other objects—for example, carriages. It is possible to state with some certainty that the pumpkin is converted into a carriage by the absorption of a fairy godmother, the carriage being an excited state. Presumably, the carriage decays after a certain period of time to the original ground state of a pumpkin, emitting one

*(*Fairy Amplification by Stimulated Emission of Godmothers*)

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fairy godmother. We know that the fairy godmother is absorbed, because after the carriage is created she no longer appears in the story. It appears, moreover, a reasonable presumption that the fairy godmother must be emitted on return to the ground state because of conservation laws covering the total available number of fairy godmothers, and also the fact that the fairy godmother is available for another story later.

Now, beginning with these basic principles, it was realized that, although it is possible to produce the excited state (carriage) in a statistically small number of cases by absorption of an available fairy godmother, it might also be possible to produce this excited state by modern methods of production and technological mediums, so that we will have an abundant supply of carriages. Our most successful experimental model to date involves a large original supply of carriages, arranged into a latticework, very closely packed in relation to each other, and placed between two flat untenable positions. In this particular experiment, the untenable positions utilized were Sin and Lechery. Sin, as the literature shows us, is perfectly reflective for fairy godmothers. Lechery, on the other hand, is in some cases apparently justifiable, and, for this reason, provides a finite probability of a fairy godmother tunneling through it, appearing on the other side and racing off in the form of propagating waves suitable for scattering experiments and the other basic experiments of spiritual physics.

The carriages being arranged in a laboratory, we remained as observers until, at the stroke of midnight, the first of the carriages decayed from its excited state into the ground state (pumpkin), emitting one fairy godmother. The fairy godmother oscillated rapidly back and forth between our two flat untenable positions, in one of the normal modes of the cavity, stimulating the emission of further fairy godmothers and the decay of the entire lattice of carriages into the ground state (pumpkins). As we had hoped, a known percentage of this accumulation of fairy godmothers tunneled out through our flat untenable position of Lechery, and appeared in the form of a coherent beam. For the first time in history, we have been able to produce, in a laboratory setting, under rigid control, a quantity of coherent fairy godmothers.

Further results are expected from our outlined series of experiments in the problems of elf consistency. We are awaiting for this work a Foundation grant-of-aid.

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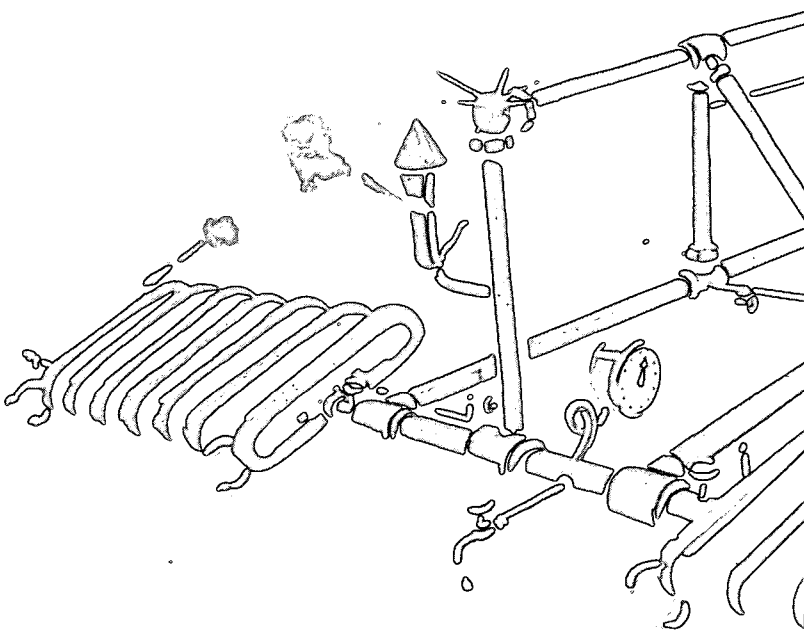
Onward and Upward with Space Power

The problem of adequate power supplies for space vehicles is admittedly tough. But there's a far, far tougher problem—getting bureaucrats to look at facts that go counter to the theory they've already staked their bets on!



J. Frank Coneybear

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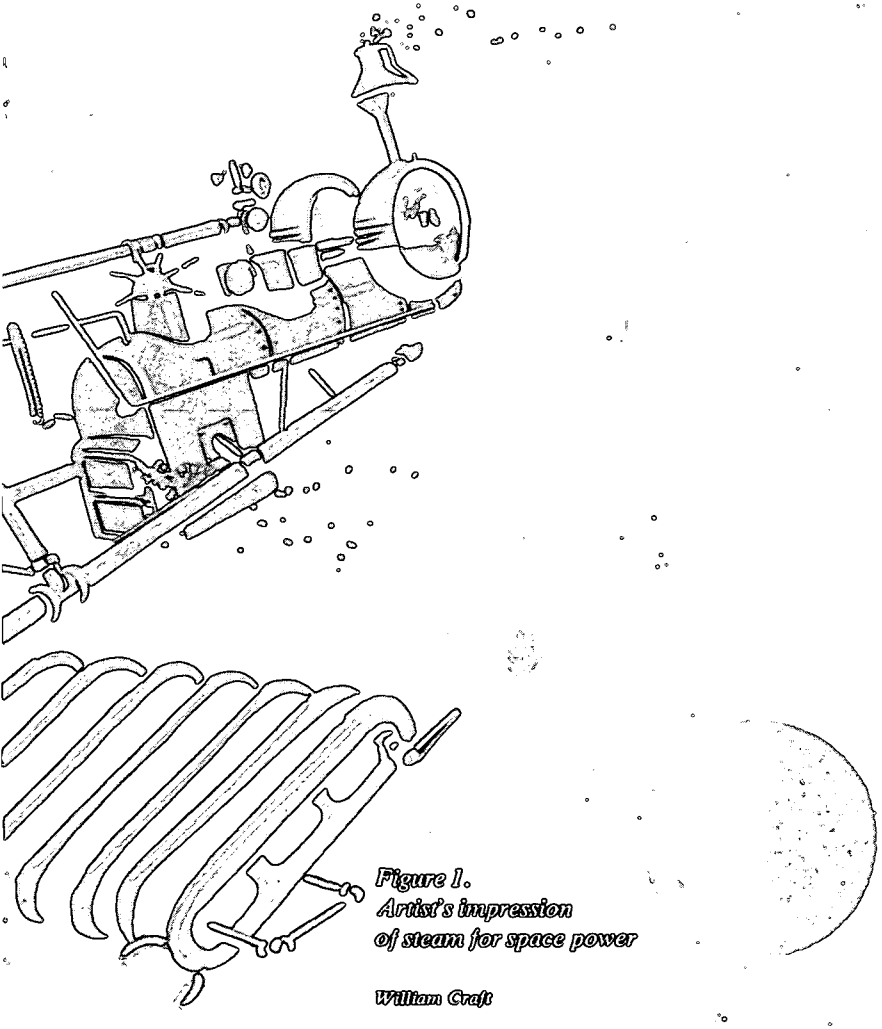

Figure 1.
Artist's impression of steam for space power

William Craft

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Dr. Coneybear is president of Astra Research Associates; he and several of his co-workers worked on the thermodynamics problems of the original Manhattan Project, and helped design many of the subsequent experimental and research reactors.

What fools we were! It was fine to show a way to save millions of dollars and years of effort in space power. It was foolish, though, to expect people to be enthusiastic over our results, or to use them. How could we be so naïve, and after all the Campbell editorials we had read!

What did we do? We showed that in space power systems it is *not* necessary to use mercury, or sodium, or potassium, or lithium, or rubidium, or even boiling sulphur, as a working fluid. We showed that with the right design one can use that old, prosaic, fuddy-duddy fluid, water.

Sound ridiculous? It's quite possible, though, and the results need-n't look like Figure 1; in fact, they could look more like Figure 2. If the use of water and steam seems odd, don't be bothered, it seemed odd to the experts, too.

Since we mention working fluids we must be talking about thermo*dynamic* space power systems, with turbine and generator, rather than direct conversion systems, such as thermoelectric or thermionic. For high powers or long missions the fluid must also go back to the heat source; if thrown away, the weight of fluid required would be too great. The system must, therefore, be "closed," with a pump to return the fluid. Lastly, to keep the pump from using more power than the turbine develops, there must be some sort of condenser, or other heat sink, between the turbine and the pump. (Diagrams of two types of dynamic systems are shown in Figure 3.)

In space the only way to get rid of heat—without getting rid of material—is to use thermal radiation; therefore, dynamic space power systems must have "radiators." The use of radiators, plus the need for low weights, set the differences between space power systems and ground power systems.

The radiator, itself, is a nuisance. Its temperature, size and shape determine its ability to get rid of heat. Its temperature and shape, however, are affected by the fact that heat is carried to it and through it by fluid flow, and across it by heat flow. Fluids require tubes, tubes require headers, headers require feeders, and the whole assemblage must work in space after a high acceleration boost. To top it all, everything carrying fluid must be armored against micrometeoroids.

Micrometeoroids are very small particles, encountered in space, that zip about at speeds of $\sim$ 15 miles per

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Ed Price

Figure 2. Communication Satellite. (Mission—3 Channel TV Rebroadcasting, ASTRA Concept 50 eKw Steam Space Power Plant).

second.[1,2] They go so fast that despite their small size and weight they can "blast" little craters which would let the fluid leak out of radiators. Since complete protection from micrometeoroids would be impractically heavy, the design approach is to prescribe wall thicknesses for tubes, et cetera, at values which will keep the *probability* that the radiator will not fail sufficiently high. A typical requirement might be a non-failure probability of .9, for a period of 10,000 hours. (Luckily, there are very few large particles, as can be seen from Figure 4.) It is also lucky that the best shape for the radiator—or at least the fin and tube part—is the simplest, looking something like the examples shown in Figure 5.

Despite what has been said about working fluid *possibilities,* the facts are that about 1958 the dynamic space power business started on a metal vapors kick which has shown few signs of remission. How did this happen? Good intentions and the scientific method!

As you know, it is impossible to study a system in *complete* detail since it is, after all, part of an extremely complex universe. Therefore, one studies a simpler abstraction of the real system. Equally important, however, is checking the limits within which the abstraction is sufficiently accurate.

With radiators—and because of the Stefan-Boltzmann law—the relationship which leaps to the eye is the one which says that the area

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needed for heat rejection is inversely proportional to the fourth power of the effective radiator temperature ($1/T^4$). By an easy extension one can then assume that the radiator weight is *also* proportional to $1/T^4$.

When comparing working fluids, however, this apparently reasonable assumption can give grossly misleading results. The reason is that the combination of tubes, headers and coolant weighs more than the fins. (See Figure 5.) Therefore, an increase in fin area and weight—as by using steam at a lower temperature than would be proper for metal vapors—can be more than offset by a decrease in the total weight of tubes, headers, feeders, and coolant. Also, any increase in efficiency from lower temperatures means less total heat to reject.

Anyhow, the experts, both industrial and government, didn't, apparently, check the validity of the area-weight assumption. Being more fascinated with the concept of high temperatures than worried over the difficulties of achieving them, they set the initial direction of the space power program by writing and talking of the need for ever-higher radiator temperatures.

This was reinforced by government contracts to investigate metal vapor systems. It was also strengthened by people in the government agencies who had a quite laudable desire to obtain more results per government dollar. In pursuit of this they attempted, in development contracts, to also "advance-the-state-of-the-art." Such an invitation to do things the hard way can increase costs amazingly. Worse, it can convince people that proposing outside of the pattern is commercially useless, even if technically desirable.

Some of us at ASTRA, however, in particular Henry Kroeger,* thought that it might be possible to develop steam systems which would be weight-competitive, and that this should, eventually, be of interest to the agencies. (The technical convictions were partly due to some 1952 studies, pre-ASTRA.) It seemed almost self-evident that steam systems would be easier to develop and have better reliability.

Accordingly, we began a study which continued in varying intensity for five years, was increasingly successful technically, and was never successful commercially. Finally, it never changed the core of a program which involved spending $100 million per year on much more difficult approaches.

Considering that the work was mostly internally supported, by a very small company, the output was quite respectable. It included analytical techniques adapted for steam, a parametric study at low powers, a design study for a TV satellite power plant, a design study

* Vice President, ASTRA, Inc.

Figure 3. Comparison of steam and mercury systems.

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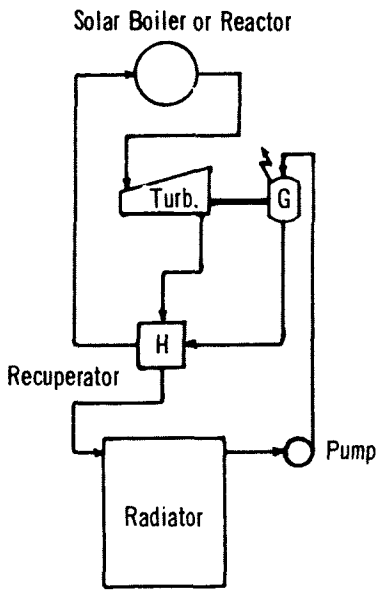
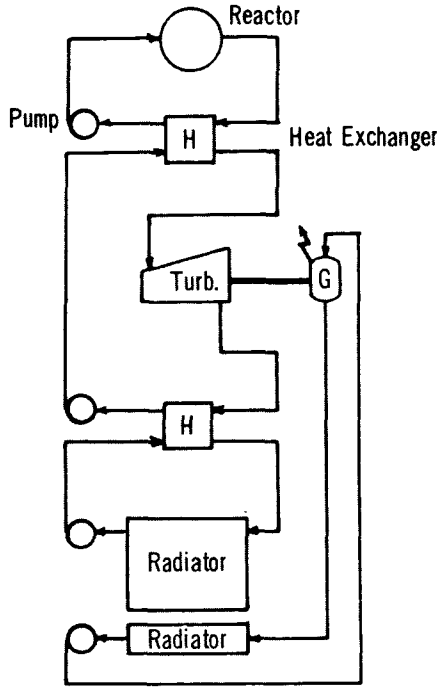
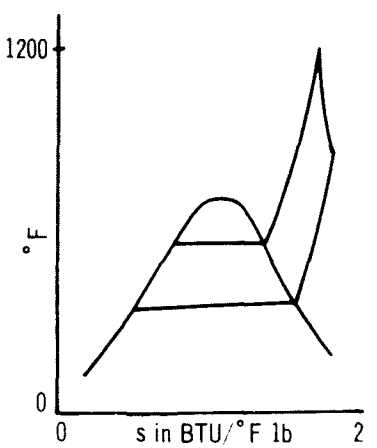


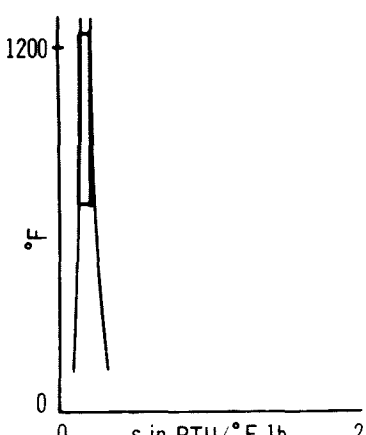
(a) Steam System Cycle



(b) Metal System Cycle



(c) Temperature – Entropy, Steam



(d) Temperature – Entropy, Mercury

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Characteristics	ASTRA Solar *Steam*	ASTRA Nuclear *Steam*	SNAP-8 Nuclear *Mercury*
1. *Powers* (kw)			
a. Net Power, Electrical	35	35	35
b. Thermal Power	200	300	400
c. Heat Rate to Radiator	165	265	365
2. *Subsystems* (No. of Units)			
a. Fluid Loops & Pumps	1	1	4*
b. Auxiliary Radiators	0	0	1
c. Solar Collectors	1	0	0
d. Nuclear Radiation Shields	0	1	1
3. *Temperatures* (°F)			
a. Top Power Conversion Temp.	1,200	1,200	1,250
b. Bottom Power Conversion Temp.	280	400	700
4. *Areas* (sq. ft.)			
a. Collector (Projected Area)	3,350	—	—
b. Radiat*or***	1,380	1,170	1,400
c. Radiat*ing***	2,760	2,340	1,400****
5. *Weights* (lb)			
a. Collector	670	—	—
b. Heat Storage & Boiler	730	—	—
c. Shield	—	1,300	1,300
d. Radiator	600	470	?
e. Total	2,360	2,800	6,100
6. *Specific Weights* (lb/ekw)	70	80	175

Table 1. Comparison of Several 35 ekw Dynamic Space Power Systems

* NaK in the reactor loop, mercury in the power conversion loop, organics in the heat sink and component cooling radiator loops.
** The radiat*ing* area is twice the radiat*or* area for flat radiators, radiating from both sides.
*** The SNAP-8 radiator was originally assumed to be part of the skin on the conical nose of the vehicle. Although it has long outgrown the nose, it is still assumed to radiate from the side only.

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for solar dynamic space power systems, a comparison between high power steam and potassium vapor power plants for electric propulsion, and many auxiliary studies.

The TV satellite mentioned, if equipped with a steam power plant, might look a bit like Figure 2. The power plant has been described in the international journal, *Advanced Energy Conversion.*[3]* In brief, the results showed that an RCA TV satellite concept[4], which had been shelved because of deterioration in the characteristics of the planned metal vapor power plant, could be successful with steam. The thing that makes this and other steam space power systems practical is the net interaction between working fluid characteristics and system characteristics. Before we discuss these, however, it might be interesting to compare the principal features of several different systems.

First, let's look at three 35 ekw systems, two of which use water as the working fluid and one of which uses mercury. Of the steam systems one uses solar heat, one uses nuclear reactor heat; the mercury system uses nuclear reactor heat.

The steam systems are from ASTRA design studies, with arrangement and cycle essentially as shown in Figures 3a and 3c. The mercury vapor system is a version of the SNAP-8 plant, the only nuclear dynamic space power plant actually under development.* (The design features are synthesized from several announcements; we have not seen a complete and consistent set of characteristics.[5]) The arrangement and working fluid cycle are essentially as shown in Figures 3b and 3d. The resulting principal features are shown in Table 1.

As can be seen, there are interesting differences, mostly in favor of steam, between items such as heat rate to the radiator, number of components, minimum cycle temperature, radiator area, and weights. Why?

As to radiator heat rates, the values are smaller for steam—i.e., there is less heat to get rid of—because of higher efficiencies. Higher efficiencies, in turn, come from greater differences between top and bottom temperatures. This effect on efficiency is reasonable when we remember that the maximum possible efficiency—Carnot efficiency—equals $(T_1—T_2)/T_1$.

As to loops and pumps, the metal vapor system has three more loops than the steam systems; it must, therefore, have three, extra, power consuming, pumps. For component cooling the need for an extra loop is almost obvious. One simply cannot successfully cool generators, shaft seals, et cetera, with a 700°F fluid.

* Portions of the work described in this paper were sponsored by Advanced Military Systems, Radio Corporation of America.

* Its future is unclear. It had been supported by the AEC and NASA. NASA has withdrawn support. Relatedly, the 1,000 ekw SNAP-50 is in a research status.

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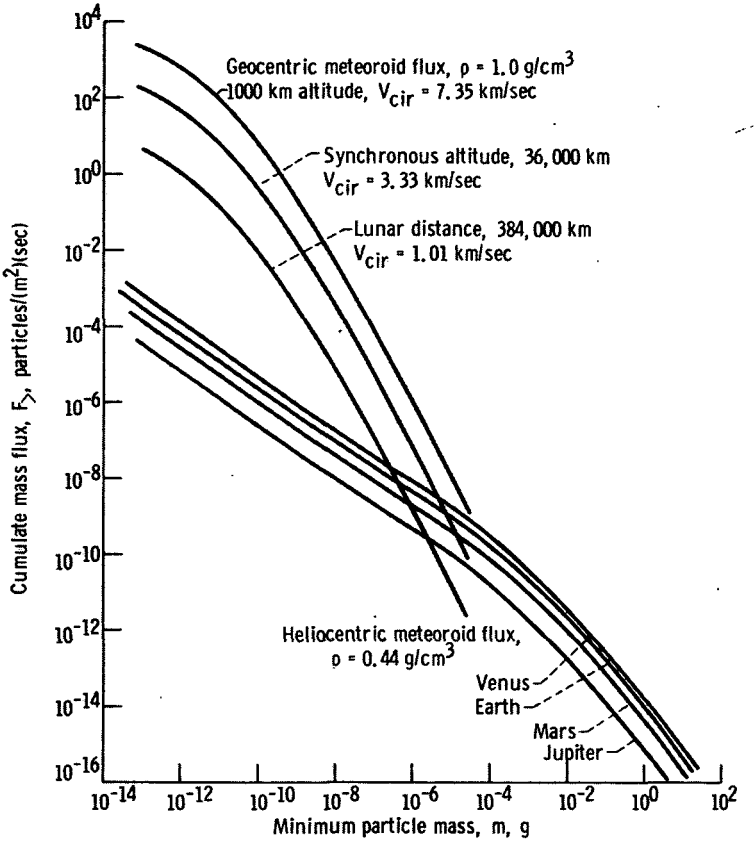

Figure 4. Geocentric-heliocentric meteoroid flux model.

The designers of the SNAP-8 system are believed to have gone to separate reactor and condenser loops because of worries over flow instabilities, especially of the parallel flow type, in a zero gravity environment.

Parallel-flow instabilities would be impossible in either the steam reactor or solar boiler, because the steam generating part is a "Sulzer" type, once-through, Monotube, boiler-superheater. (This would make it a much smaller brother of the 1,200 F, 5,000 psi Sulzer steam generators built recently by Combustion Engineering for the Philadelphia Electric Co.[6])

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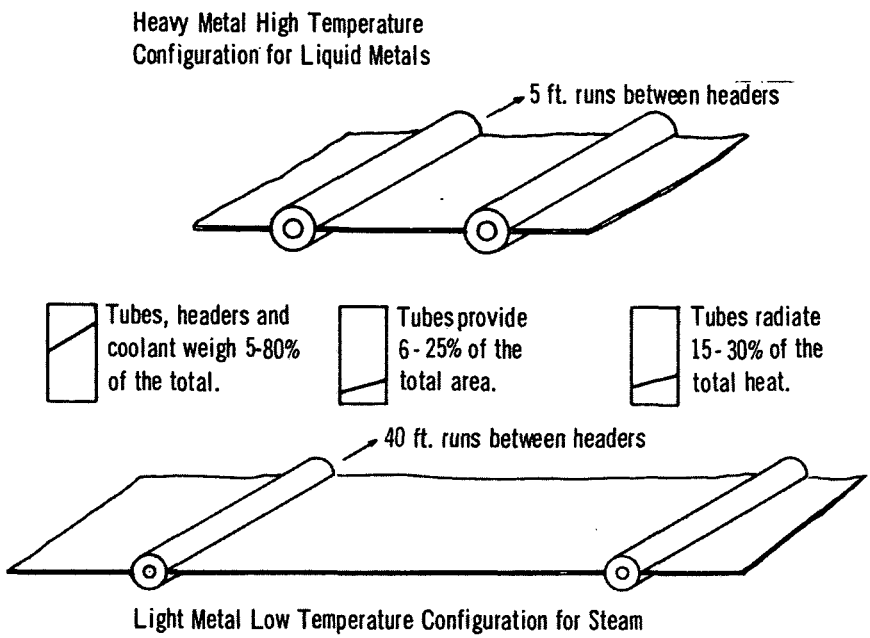
Heavy Metal High Temperature
Configuration for Liquid Metals
5 ft. runs between headers
Tubes, headers and coolant weigh 5-80% of the total.
Tubes provide 6-25% of the total area.
Tubes radiate 15-30% of the total heat.
40 ft. runs between headers
Light Metal Low Temperature Configuration for Steam

Figure 5. Typical radiators.

Steam condensing radiators can operate efficiently with pressure drops which would be quite impractical for metal vapor condensing radiators.* With large pressure drops they can be designed for a flow regime in which instabilities are not a problem.

In Table 1 the weights are less for the steam systems because the working fluids weigh less, because there are fewer components, and because some apparently similar components can be made lighter. For example, as specified for the steam systems in Table 1, the radiator can be made of light-weight metals such as aluminum. (Incidentally, the weight-saving, increased spacing between radiator tubes, as shown in Figure 5, is due to the better thermal conductivity of materials such as aluminum.)

The solar dynamic system is of interest because of the advantage of no nuclear radiation to worry about, plus the administrative advantage of involving only one government

* The drop in temperature with decrease in pressure is a great deal less for saturated water vapor than for pertinent metal vapors.

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agency.* For such systems the collector is more of a worry than the radiator. For this reason steam systems with their higher efficiencies have a definite advantage. Also, as between nuclear and solar, the solar will be designed for lower radiator temperatures, as can be seen in Table 1, in order to minimize collector and heat storage weights.

The major problem with the collector is not its weight, as such, or even the details of how it is to open from its boost package. It is, rather, the need for very accurate contouring so that essentially all of the sun's rays will reflect into the rather small region needed for a "black box" solar boiler. This is necessary to maintain efficiency, and all of the development steps are not yet clearly seen. A small but growing body of opinion that one should assume adjustment in place, by men in space, would greatly decrease the difficulty, and make somewhat larger solar power plants more practical.

The kind of comparison we have just made has provoked objections

* No matter what agency is involved in the use of a nuclear power plant, the AEC must, by law, be involved in its deveopment.

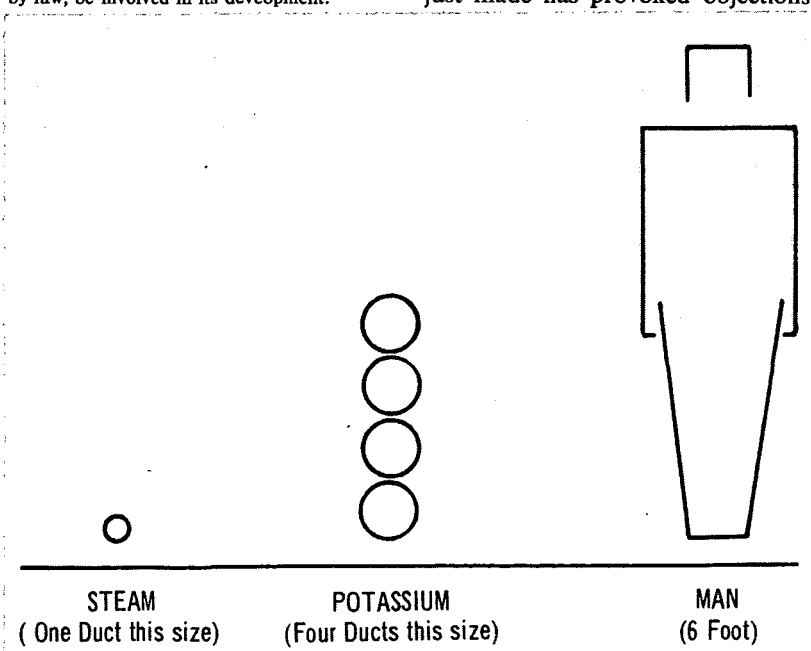

Figure 6. Sizes of turbine exit ducts for 1 emw space power plants, steam and potassium.

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from people committed to metal vapor systems. They point out that it is a comparison of a design study with a system which deteriorated badly after its original design study. (SNAP-8 progressed from 2 loops to 4, from 400 sq. ft. of radiator area to 1,400, and from 2,700 pounds weight to 6,125.)

This, although true, does not constitute a valid objection since it ignores a principal advantage. Even at an early stage, the problems of steam systems are considerably closer to engineering than to research —especially as compared with a metal vapor system. It is not necessary, therefore, for steam systems to suffer the same deterioration during development as experienced by metal vapor systems.

Metal vapor enthusiasts also point out that the feeders, headers, et cetera, of their systems are so massive that the system itself can provide vehicular bracing. This is really making a virtue out of a necessity. In any case, even if 1,000 pounds were arbitrarily added for bracing, the steam system would still be lighter.

Another potential application for space power is providing the electricity for electric propulsion. Electric propulsion, which Stuhlinger has shown is needed for manned exploration of the more distant parts of the solar system,[7] is characterized by low thrust applied for a very long time. It does not require much in the way of propellant mass but does require a great deal of electric power, on the order, say, of 1,000 ekw. Because of the large power requirements it seemed desirable to see how steam systems could compete for such an application. Therefore, a comparison was made based upon a good design study of a potassium vapor nuclear power plant for electric propulsion.[8]

In order to compare on an equitable basis weights and other characteristics were examined subsystem by subsystem—in many cases, component by component—and the assumptions and calculations used were at least as conservative as those used for the potassium system; for example, eight separate radiator segments were assumed, in order to provide isolation in case of meteoroid puncture.

The results are shown in Table 2. Notice the recurring theme of lower temperatures, fewer components, and lighter weights. The lesser requirements as to gross electrical power and gross thermal power are also of interest.

The principal reason for the lower gross thermal power is due, however, to an appreciably higher thermal efficiency. This, again, is due to a greater temperature spread—800° vs. 600°—as well as a lower top temperature—1,200 F vs. 2,000 F. (Remember the $[T_1—T_2]/T_1$ Carnot efficiency.)

The difference between the weights of the working fluids for steam and potassium is of consider-

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Characteristics		*Potassium*	*Steam*
1.	*Powers* (kw)		
a.	Net Power, Electrical	1,000	1,000
b.	Gross Power, Electrical	1,390	1,265
c.	Thermal Power (reactor)	7,600	5,730
2.	*Subsystems*		
a.	No. of Power Cycle Loops*	4	2
b.	No. of Pumps, non-Radiator	4	1
c.	No. of Radiator Segments & Pumps	8	8
3.	*Fluid Temperatures* (°F)		
a.	Top for System (reactor exit)	2,000	1,200
b.	Top for Working Fluid	1,850	1,200
c.	Main Radiator Exit	1,075	370
d.	Component Cooling	550	370
4.	*Weights* (lbs)		
a.	Working Fluid	3,511	230
b.	Electric Generating Package**	8,030	4,260
c.	Total***	29,550	25,340

Table 2. Comparison of Typical 1 emw Water and Potassium Space Power Systems

able interest. Also of interest—although not shown in the table—is that even though the fins and tubes of the potassium radiator are quite a bit lighter than those of the steam radiator, the total radiator weights are about the same, despite a ton of structure arbitrarily added for bracing during boost. The reason is that the feeders, headers, and working fluid are quite a bit heavier in a potassium system.

Also not apparent from the table is the fact that for electric propulsion missions, potassium has the disadvantage that if the plant is shut down the radiator fluid freezes. This makes restart difficult. For many missions water will not freeze and, in any case, the weight of water in the radiator is small enough to make jettisoning and refilling quite practical.

* Considering the radiator as one loop.

** Not including reactor, shield, or power conditioning equipment.

*** Including reactor, shield, and power conditioning equipment.

Figure 7. Radiator characteristics, steam and metal vapors. (Normalized. Smallest is best. System temperatures: H_2O, 1200 & 400 F; Hg, 1250 & 680 F; K, 2000 & 1400 F.)

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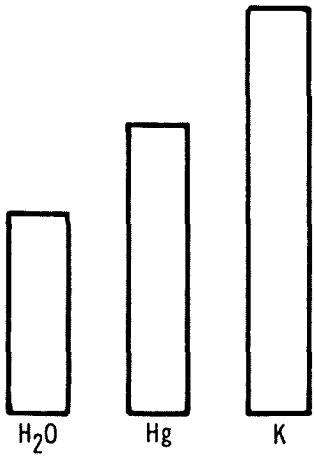
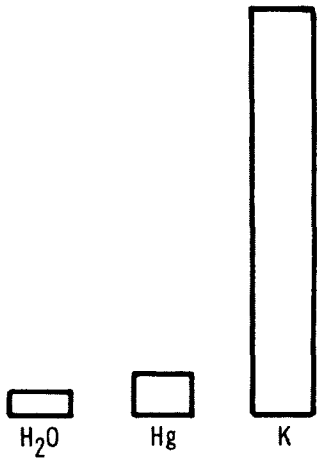
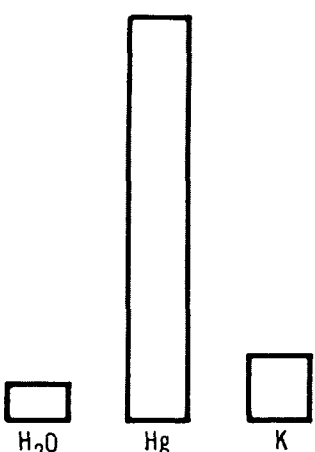


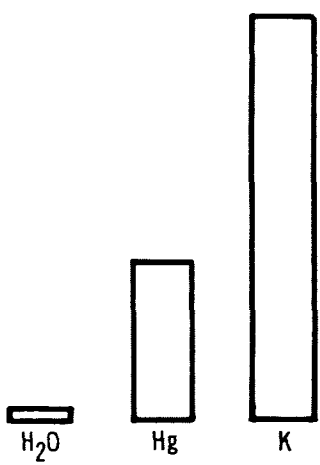
(a) Heat to Radiator



(c) Specific Volumes,
Low Temperature Vapor



(b) Mass Flow Rates



(d) Volume Flow Rates
Low Temperature Vapor

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Of course radiators for high power steam systems must have large areas; however, the advantages bought by this are worth it. Although stowing and unfolding such a radiator could be a major mechanical problem it does not, after all, require raising the whole level of high temperature technology.

Now let us look at some generalized concepts, and, possibly, answer

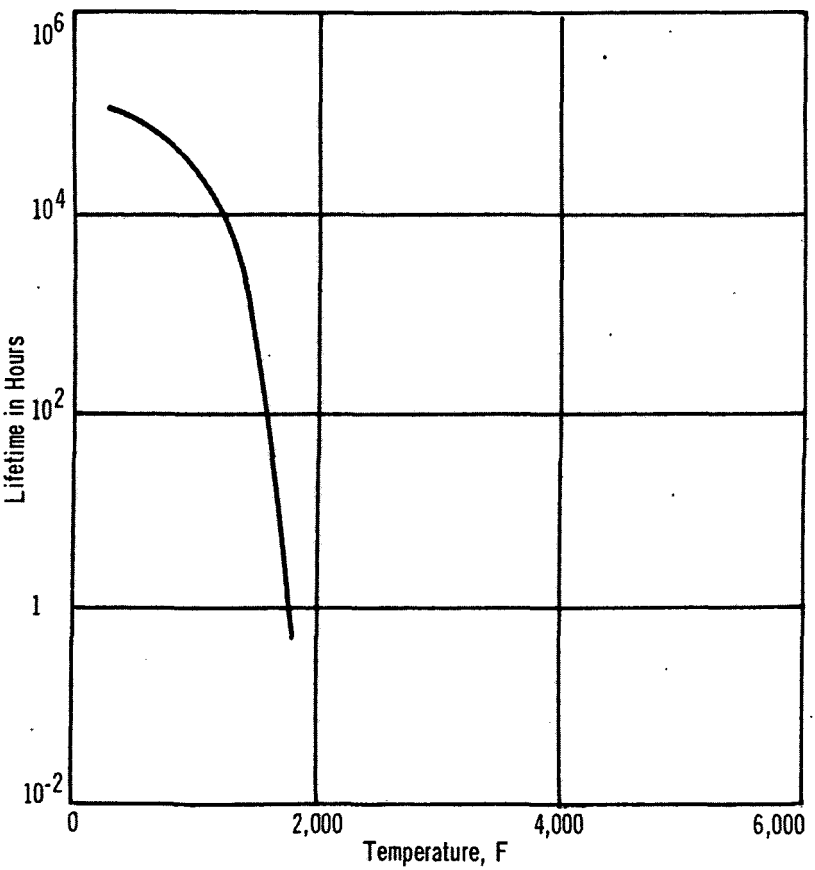

Figure 8. Lifetime for power plant rotating machinery vs operating temperatures. (Obtained by Interchanging Coordinates in Figure 1, TID-20079, "An Evaluation of Systems for Nuclear Auxiliary Power," USAEC (1964).)

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some "whys." Oversimplified, metal vapor systems are high temperature systems; steam systems are high pressure systems. (They operate in the range between, say, 250 and 1,200 psi.) It is less well recognized that metal vapor systems are characterized by having large volumes—i.e., within turbines,. feeders, and headers—even as steam systems are characterized by having large areas of radiators. The effect of this on component design can be understood by comparing the sizes of the turbine exit ducts needed for the systems described in Table 2. See Figure 6.

These size differences arise from the interplay of system and working fluid characteristics, as indicated by the bar graphs of Figure 7. This graph compares water, mercury, and potassium, for systems operating at typical temperatures. (Fluid characteristics are from accepted references.[9])

The effect of relative efficiencies on heat rates to the radiator has been pointed out before. Mercury requires. high mass flow rates, per Figure 7b, because mercury has the characteristic of picking up less heat per pound in the boiler, and depositing less in the condenser, than does water or potassium. (This can also be inferred from the narrowness of the temperature-entropy diagram for mercury, in Figure 3d.)

Potassium has about the same heat of condensation as water, so that the difference in mass flow rates is due to the lower thermal efficiency of the potassium system. Potassium's main drawback, however, is its high specific volume—cu, ft./lb.,— as shown in Figure 7c. Of course higher pressures could be used, but this would result in higher saturation temperatures, and still lower efficiencies.

Finally, volume flow rates are obtained by combining mass flow rates and specific volumes. The results, as shown in Figure 7d, are indicative of relative sizes of turbines, ducts and other components.

Sizes and weights mean nothing if the power plant can't run when and where it is supposed to. A very important requirement, therefore, is *reliability*. (This fact has been increasingly emphasized in the space power program, as difficulties and weights have increased.)

The reliability which will be obtained will depend upon mission, environment, operating requirements, complexity, state-of-the-art, wisdom in design, and care in construction. The obvious difference between steam and metal vapor systems is the operating temperature.

Claims of increased reliability at lower temperatures might be controversial, except that the AEC has compiled data and produced a curve indicating expected lifetime of rotating machinery vs. temperature. This curve, reproduced as Figure 8 —with abscissa and ordinate interchanged—indicates that there is no

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applicable experience for rotating machinery capable of operating at 1,850 F for longer than an hour. Also, since lifetime drops precipitously with increase in temperature, an improvement of two to three orders of magnitude is necessary, in order to obtain a one-year lifetime at 1,850 F. Finally, if one believes the curve, the temperatures proposed for steam systems imply adequate reliability, the temperatures proposed for the higher temperature liquid metal systems imply inadequate reliability.

The sharp decrease in reliability at the higher temperatures is due to a qualitatively different operating environment. These are temperatures at which metals are beginning to glow at white heat and very few components work well at a white heat. These are temperatures at which all but a very few materials tend to come apart,* and those which can be used are mostly difficult to work with.

Even the lowest potassium system cycle temperatures—$\sim$1,000 F—can cause difficulties. Reliable operation of bearings at such temperatures is improbable. The practical operation of generators at such temperatures is presently impossible. This implies a need for separate coolant systems for components, and for shaft seals between rotating components. Such increased complexity further decreases reliability.

An example of one ingenious but complicated shaft seal design is shown in Figure 9, taken from *Machine Design.** It requires: 1) a mercury molecular pump, 2) a coolant for the mercury, 3) an oil molecular pump, 4) an oil cooler, 5) a radiation-resistant oil, and 6) two "start" seals that can operate only at startup. (This means the system can only be started up once; *no* restarts.)

Steam systems, on the other hand, have low enough bottom temperatures—300-400 F—to permit the use of water lubricated bearings and direct cooling of generators, and no seals between components. Auxiliary heat exchange systems and radiators are not needed and repeated startups are quite practical.

No matter how carefully a complicated system is designed, however, be it power plant, space vehicle, or even submarine, it will, upon occasion, give trouble.** For manned missions, therefore, the attribute of *repairability* which makes emergency—admittedly difficult—in-the-field repairs possible, is almost

* It may be helpful in obtaining a "feel" for the tendency of components to deteriorate at these high temperatures to realize that one type of white cast iron can actually melt at a temperature 80°F below the 2,000 F cited in Table 2, and for SNAP-50.

* By permission. *Machine Design*, October 22, 1964. Copyright 1964, by the Penton Publishing Co., Cleveland, Ohio.

** Examples in support of this include difficulties encountered with the Hallam liquid metal reactor, the "Ranger" series of space shots, and the first completely submerged submarine voyage around the world. The last is of special interest, because of many examples of dangerous failures to complicated equipment repaired by a completely isolated crew.[10]

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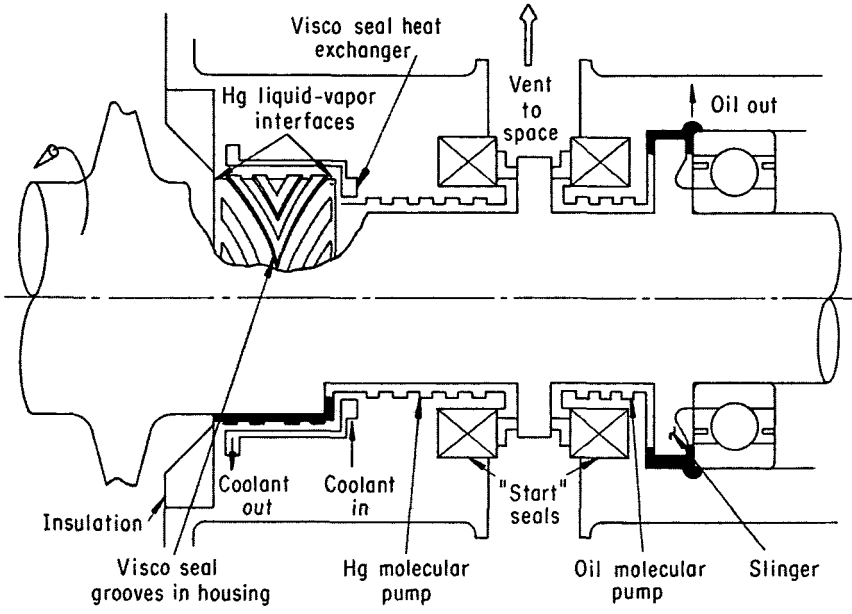

Figure 9. Molecular pumps back up snap-8 shaft seals. ("Start" seals contain the fluids during startup, rub away during flight.)

as important as reliability.

Jury-rig repairs to power plants can range from stopping leaks to draining part of the system and removing and repairing a component. It would obviously be easier to drain water and repair an aluminum or steel component, than to drain potassium, and repair a stainless or niobium component. Also, consider the effects of a "small" potassium leak and fire in a dome or cabin!

To be practical, repairability must include the possibility of recharging the system. It is pertinent that water will be the only item on manned missions which will routinely be supplied in more-than-adequate quantity. Further, recharging a 1,000 ekw steam system would require at most 250 lbs. of water; a metal vapor system might require up to 3,500 lbs. of potassium. In sum, a breakdown, or loss of fluid, is much less apt to prove fatal if the power plant uses water.

Technical advantages are important but relative costs are still a factor. For many reasons, includ-

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ing the more advanced state-of-the-art, and the fact that steam system components—except the reactor—can be tested with little or no special facilities, large sums could be saved by a switch to steam, despite the money already spent. We believe that a twenty per cent savings on future programs is quite conservative. Actually, a fifty per cent savings could be realistic if careful development approaches were taken.

The dollar values of such savings are impressive. The dynamic space power program is supported at about $100 million per year. The consensus of several knowledgeable groups is that it will cost $.5 to $1.5 billion to develop a metal vapor system—SNAP-50 type—for electric propulsion. Even modest percentages of $1 billion represent very respectable savings!

Finally, both technical and financial advantages are academic unless they can be reduced to practice. Dynamic space power systems still have only one class of customer, the government agencies. They also cost too much to be developed with private funds and sold to the government as a demonstrably successful piece of hardware. (Even the cost of a prototype test is excessive.) Therefore, dynamic space power systems must be developed under direct government support.

The people responsible for that support will not have the staff to carry out long, grubby, detailed studies, or the equipment to work with hardware; they must, therefore, act through industrial contractors and government laboratories. They would be less than human if they did not become convinced that some particular direction of effort is correct, and feel duty-bound to push in that direction. Because of this a network of contractual provisions, directives, and procedures must inevitably develop. Such an alignment of effort can facilitate progress; it is also an excellent homeostatic mechanism for resisting change when the progress is in the wrong direction.

In addition, to change a program requires that many responsible people change their convictions. This can be especially difficult for a change to an easier approach. It is not in human nature for people who have argued, written, and worked for a difficult and expensive program to really believe that they could have taken a better and cheaper approach.

Because of these factors it is very difficult to effect any changes to a program from the outside, especially when using studies rather than test results as ammunition,* and especially, again, when the change is to an easier approach. Specifically, to bring about any major changes to the space power program proved, for us, impossible. A brief account

* In contrast, Whittle, in developing jet propulsion, was able to silence many doubters in high places by achieving a one hour prototype test.

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of our small successes, plus our inability to obtain major changes might, however, be helpful to people who want to obtain acceptance of a technical approach, and who underestimate the difficulties—as we did.

Our push to obtain acceptance can be divided into five phases including: 1) attempting to obtain a hearing, 2) obtaining a small contract, 3) making joint efforts, 4) contributing to a change in a small program, and 5) working on high power systems.

During the first phase nobody would even listen. The universal reaction was "How *can* it be lightweight with a low temperature radiator!" There seemed no realization that "the map is not the thing" and a flat plate is not a radiator. This phase, during which a number of minor studies were carried out, using abbreviated calculations, lasted from the end of 1959 to mid 1961.

Finally, after a great deal of effort a small contract was obtained from NASA, our first and last government contract on space power. Pertinent to this, a special acknowledgment is due Mr. William Woodward of NASA who, although dubious—he still is!—felt a need to make sure that nothing really worthwhile was missed.

Under the contract, the radiator optimization techniques developed for steam obtained approval, and results by more approximate methods were substantiated and extrapolated. A check calculation on contract results, by NASA, in the form of a comparison with a low power, mercury, solar heat system, showed slightly better weight per kilowatt for steam. On the other hand, the contract cost more than was received, and a complete lack of interest in steam remained. This phase lasted from mid 1961 to early 1962.

After this an attempt was made to team up with large companies. Although there was no interest by those already in the program—because each was pushing a favorite entry—interest was aroused in other companies; for example, Texas Instruments, and RCA.

Texas Instruments, Inc., an ASTRA client, is a principal world supplier of nuclear fuel elements through their M&C Division. After a review of ASTRA's analyses, by TI's laboratory, a joint presentation was made to a major government agency. TI was represented by a senior vice president, and other top people, as was ASTRA. During the presentation it was proposed that work start immediately, with a ground test prototype to be running by a specified early date. Essentially no comments or questions were made by those who attended the presentation. Neither an answer nor an acknowledgment was ever received to the proposal.

The work with RCA on a power

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plant for a TV satellite was started after a review of ASTRA's analyses by independent consultants to RCA—from a university. It did not result in any continuing effort since RCA had no intention, apparently, of supporting a space power development program, or starting the thankless task of trying to change a funded program. The agencies were not about to launch a program to compete with the one under development.

During this period joint proposals were also made with a nearby university. These joint venture efforts took up most of 1962.

In December 1963 we received an invitation from Wright Patterson Air Force base—as did companies with funded projects—to submit—without obligation—any information on working fluids and systems which would be applicable to their ASTEC—Advanced Solar Turbo-Electric Concept. Information on steam was submitted in a long report called, "The Case for a Solar Steam Space Power System."[11]

In jest, we said that if they made an objective comparison they would pick steam.* They shamed our skepticism by making a long, detailed, and objective analysis and deciding that steam *was* best for their requirements, and that its performance would be surprisingly good relative to other concepts. (These results, sent to all who submitted input information, were picked up and published by *Missiles and Rockets* as "Steam Concept Interests Air Force." [12])

The choice of steam caused a minor flurry of interest, in which some were surprised and others incredulous. It did not lead to continuing work, as there were no funds for further systems studies, and other groups remained unconvinced. This period, with its disappointing example of technical acceptance without any fruitful change in the basic situation, took up the first half of 1964.

Finally, during the last half of 1964, studies were made of high power systems suitable for use with electric propulsion systems.* In addition to information of the type shown in Table 2, it was found that steam had certain advantages in component cooling and mission flexibility. (It was even found that, if steam were used in the power plant, steam jets could be used for intermediate level auxiliary thrust, for docking, maneuvering, et cetera.

Interest in the use of steam for space power was aroused among those working on electric propulsion, who feared a lack of high output power plants for their propul-

* We would like to acknowledge our gratitude to the Head of the WPAFB space power group, Mr. George Thompson, who always seemed to succeed in being patient, interested, and objective.

* A few people were beginning to agree that steam might be weight-competitive at the lower powers, but continued doubtful for high powers.

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sion systems.* The steam approach also interested Dr. Ernst Stuhlinger, the long time proponent of electric propulsion, who was kept aware of our progress, and who kindly mentioned steam space power systems in a recapitulation of the status of electric propulsion.[7]

A proposal for further investigation of steam systems for high power was submitted to one of the agencies which was managing major space power programs. We submitted detailed check calculations on a specific radiator design showing that steam radiators could be adequately light. Despite these, and the previous findings of independent consultants, they continued to believe results which indicated that steam system radiators would weigh too much.**

Thus ended our technological tilt with the windmills of space power; we had used up our lances and worn out our horse. The moral seems to be that it is too difficult to effect changes; in fact, it is much too difficult to even obtain a friendly hearing, and a detailed, objective evaluation. This seems especially true if the concept is one which might change a thoroughly committed, well publicized, well funded program.

This is not new, and past results from competition between flexible and inflexible approaches should be of interest. For example, Nevil Shute Norway [13] has compared the approach taken and the results obtained on the R-100 dirigible, in 1930, with those of the Cardington laboratory, on the R-101.:

> ". . . We could go to no great expenditure upon experimental work; we were supposed . . . to be able to build an airship as a bridge might have been built. On the other hand we had freedom to change our minds and to make rapid alterations in policy and design . . . we changed our engine policy three times.
>
> "At Cardington . . . they built an entire experimental section of the ship and made innumerable experiments on such accessories as gas valves, servo motors, steam heating of the passenger quarters, evaporative cooling of the engines, et cetera . . . On the other hand, it appeared that once they were committed to a definite policy with regard to R. 101 it was difficult for them to change their minds; if public money had been spent upon an article for the ship, into the ship it had to go."

The R-100, which was built with inadequate funds but with a flexible engineering approach, lost money for its company but made a successful maiden voyage to Canada. The R-101, which was built with extensive research but with irreversible decisions, cost much more and, while on its maiden voyage to

* One prediction was a fifty year development period, at the present level of funding.
** We were never shown the analyses leading to these results.

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India, crashed and burned in France, killing nearly everyone aboard, including those most responsible for its existence, its chief designer and the Secretary of State for Air.

Is it fortunate or unfortunate that there will be little room for designers and administrators in the spaceships of the future?

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Kelly Freas

Space Pioneer

Conclusion.
The peculiar special studies of a man pioneering a new planet can turn out—to his, and everyone else's surprise—to be improbably useful!

MACK REYNOLDS

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A mysterious stranger seeking a person named Peshkopi, stows away aboard the Spaceship Titov *which takes off on a colonizing voyage to the new planet New Arizona. He manages to take over the identity of ROGER BOCK, one of the board members of the monopolistic New Arizona Company who failed to embark.*

The false Rog Bock soon discovers that the spacecraft is a nest of intrigue in which the Company members and colonists are arrayed against each other, but also conflict within their own ranks.

Board member CURRO ZORILLA soon discovers his masquerade but fails to expose him, using him instead as a stooge and voting his stock.

Captain BRUNO GLUCK plans the expedition as only a front for the purpose of seizing sovereignty for the New Arizona Company so that the planet can be drained of its natural resources. The two thousand colonists aboard will be left living on a virtual desert instead of a highly prized nineteenth category planet. CATHY BERGMAN, who controls one seat on the board as a representative of the colonists, fights against this and attempts to enlist Rog Bock's aid. However, in investigating the condition of the colonist dormitories, Rog is forced to kill a berserk colonist who had succumbed to the dreaded space flap.

Meanwhile, it is becoming increasingly clear that Peshkopi is either not aboard, or is in some way hidden from Bock's searching.

It develops that Captain Gluck, representing the entrepreneur MATTHEW HUNT who discovered New Arizona, plans to sell some of the new planet's mineral concessions in order to bail himself and Hunt out of a precarious financial situation. LESLIE DARLEEN, an hedonistic cynic, stays on the fence as does RICHARD FODOR, but PATER WILLIAM, a United Temple monk, seems to back the captain's plans.

When they reach New Arizona and begin to disembark, Rog Bock sees that a nineteenth category planet is Earth type in the way Earth must have been in Neanderthal times. There are even animals remarkably like deer. Pater William tells him that although this type planet is occasionally discovered intelligent life has never been met wherever man has explored.

The colonists throw up a temporary tent city, but the Company board members remain on the Titov *until suitably luxurious quarters can be erected for them.*

The captain calls a conference of all and reveals that the spaceship is in such condition that it will be impossible for her to be spaceborne ever again. Instead, he plans to remain, converting the crew, who have signed no contracts with the Company, into a special military and police. Some of the crewmen

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object to this, but there is little they can do. The Company has now met all legal requirements and New Arizona is sovereign and it's private property.

In the midst of the conference, SPARKS, the radioman, comes dashing from the ship. His equipment has been sabotaged and it will be impossible to communicate with Earth for the purpose of selling concessions.

The colony despite large numbers of malcontents and inadequate members begins to shape up. Zorilla is a competent farmer-rancher, Fodor a mining engineer who begins exploring in one of the ship's floaters. Jeff Ferguson is a jack-of-all-trades and shortly helps some of the colonists to set up a method of producing alcoholic drinks.

One night, Jeff takes Rog to Tent City's dance hall where a system of barter has grown up, berry brandy for just about any usable manufactured item. The drunken colonists, seeing Rog as a symbol of all that is standing in the way of their dreams, attack him and Jeff and they are forced to flee through the streets. Separated from Jeff, Rog finally escapes by spending the night in a tent with Cathy Bergman.

He reveals to her that his name is not Rog Bock but actually Enger Castriota, last of an Albanian clan which has clung to existence down through the generations in the hating hope of some day wiping out the Peshkopi in a gyak *feud that goes back centuries. He ruefully admits it is a wildgoose chase since the last Peshkopi is evidently not on New Arizona. However, in scorn, she tells him children under ten are not listed as colonists and since several of these are adopted and holding different names, perhaps his Peshkopi is among them.*

He returns to the Titov *in the morning to find the captain in a rage. During the night, someone has sabotaged the lifeboats thus preventing a mission to the nearest Space Forces base where communications could be made with Earth cartels and money raised selling off New Arizona rights. He contends that only board members could have done it, and consequently it must have been Cathy who represents the colonists' interests. Enger Castriota alibis her by explaining he had spent the night with her, but she enters just in time for it to sound as though he were bragging of a conquest. In a rage, she reveals he is not Rog Bock, and Enger is expelled from the ship.*

Forced to go to Tent City, he is made welcome by the colonists. But hardly has he settled in than one of the floaters, carrying Richard Fodor and three crew members comes back from an exploration flight. The craft is riddled with darts, Fodor is dead and two others dying. They have been attacked by what the survivor hysterically describes as "monkey men."

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"But," Zorilla rumbles, "there is no intelligent life in the galaxy except man."

"That was the good old days, evidently," Leslie Darleen drawled.

IX

They held another convention, somewhat different from the first one of less than a month earlier.

Different in that this time two small floaters whined anxiously overhead, flying high but scouting with scanners the forests below. They had a job on their hands. The woods were sufficiently thick with trees, ferns and underbrush that anyone native to them could have progressed, albeit slowly, without the fliers being able to detect movements.

Then there was the fact that squads of Ten Eyck's armed men were stationed at strategic points all about the settlement. Dug in, usually, but sometimes, where there were rock outcroppings, in improvised stone fortifications. At three points pillboxes were in the process of construction, but work was at a standstill until the colony-wide conference adjourned.

Nor was the lineup the same.

Richard Fodor, board member, and Manuel Sanches, second engineer and fifth owner of a board seat, were both dead of their wounds. Roger Bock was conspicuously absent from the comfortable armchair he had occupied at the last meeting, and held his position far back in the ranks of the colonists. Enger's story had quickly spread and rather than condemnation from his fellows, he found the majority had a laughing admiration for his having been able to pull off his masquerade for so long. It was obvious that nine out of ten would have loved to have had the opportunity.

Nor did Cathy Bergman occupy her chair side by side with Darleen and Zorilla. Instead, indignant at the captain's charge that it was she who had sabotaged the lifecraft and radio, she now took her place with the committee representing the colonists. Indeed, she had left the *Titov* and taken up quarters in Tent City.

Thus the board proper consisted only of Leslie, Zorilla and Pater William. Captain Gluck and his officers, controlling two votes, sat as before, aside, the captain acting as chairman. Most of the crew members and the balance of the security and police force of Ten Eyck, stood in ranks to the right—those who were not on sentry duty.

Before them, some standing, some squatting or sitting on the grass, a few on chairs they had brought for the occasion from Tent City, were the colonists and those of the former crew who had refused a place in Ben Ten Eyck's gendarmerie. Their committee now swollen to a dozen, though retaining the original three doctors as leaders, were slightly in front of their followers.

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As formerly, Pater William opened the meeting, this time continuing at longer length on the necessity for co-operation, obedience of those whom Providence had placed above one, sacrifice for the common cause, and final dependence on the powers of the faiths worshiped by the United Temple.

Enger Castriota noted that two newly converted neophytes, garbed in Temple brown, stood behind the monk. He had heard, also, that a permanent temple was being erected in stone on the outskirts of Tent City. He wondered to what extent the emergency would affect its construction.

The captain, obviously impatient of the time being consumed by the Temple monk, shot erect when the cleric finally sat down. There had been little applause, though Enger didn't know if this was for lack of appreciation of Pater William's words, or fear that the captain might misunderstand that the applause was directed toward him.

His gray eyes glowered out at them. "In all the history of man's exploration of this section of the galaxy," he bit out, "there has never been intelligent life detected. Its appearance here complicates our situation."

Dr. Hugo Miltiades came to his feet quietly. "I beg to correct you, Captain Gluck. It complicates *your* situation. You and the New Arizona Company. But it affects the colonists under contract to the Company in quite another manner."

The captain was curt, "Explain that, if you please, Doctor!"

"Earth law pertaining to space deals thoroughly with the possibility of man coming across intelligent life on other worlds. In sum, he is to refrain from all contact until Earth specialists can arrive on the scene. All explorers and colonists must be immediately restricted in their movements on the planet in question, at least until binding treaties have been signed with the new life form."

Air went out of the captain's lungs in a hiss. Facial muscles worked momentarily, until finally he found words. "However, Doctor, the Company is in no position to abide by such rulings due to the fact that we have no method of communicating with Earth, both radio and lifecraft having been sabotaged. And, since we have been attacked, we must defend ourselves."

His bleak eyes left the committee member and searched out over the body of colonists. "This expedition didn't expect to conduct military operations and armaments were minimized in view of space shortage. However, there are some one hundred firearms of various types aboard the *Titov* and charges for them.

"Volunteers will be granted release from their contracts with the Company and bonuses upon the ending of the emergency."

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Little Samuelson, once of the crew but now sitting among the colonists, shot to his feet belligerently. "Where's the exchange for the bonuses coming from, Skipper? We understand the Company's broke. Why don't you face it? We've got a fight on our hands and you people ain't in no position to handle it. Turn the blasters over to us, and everything else. We'll get to work and make more weapons. We'll fight these monkeys off until help comes."

The captain snapped, "That will be all, Samuelson. More from you and you'll be in the brig on bread and water."

"I could use some bread," Samuelson shrilled back at him. "We're running out of flour. How're you going to feed us, when the hunters and fishermen'll be afraid to go into the woods?"

Ben Ten Eyck came to his feet, his hand on his holstered blaster.

Samuelson faded back into the crowd behind him.

The captain looked out over them again. "Volunteers will get in touch immediately with Mr. Ten Eyck."

Zorilla lumbered to his feet. "Might I make the suggestion that, although we have but a hundred available firearms, there is no reason why the rest can't be armed with, say, pikes and possibly some type of sword. After all, we're faced, from what young Webster said, with opponents not far above the brute animal stage."

Leslie Darleen said mildly, "Brute animals don't manufacture blowguns, Curro, old boy. The Indians are upon us, we can't let the Cowboys go out armed with nothing but pikes."

Zorilla turned on him. "Leave fighting to fighting men, Leslie. There are at least a thousand men and women in our colony capable of bearing arms. It'd be better if they were all equipped with automatic weapons, blasters, nuclear bombs and what not—but we're fresh out. We're going to have to fight with what we have and what we can make."

Leslie drawled, "My dear Curro, you can fight with whatever you want and however long you want. But you're not going to get me out into those woods armed with a pig sticker, thank you. I'll stick to the *Titov* with a few men with guns around me."

Zorilla began to retort but the captain came in heavily. "Citizens, some elements of this matter will have to be discussed in executive session."

Cathy Bergman spoke up for the first time. "Be sure that I am notified when such board sessions are called, Captain Gluck."

The captain glared at her.

Shackleton, who was sitting on the ground next to Enger Castriota, grumbled, "What's going on? I don't get half of it."

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Enger said thoughtfully, "The captain's hanging on with the tips of his fingers. What Dr. Miltiades said, in effect, was that the Company was obliged by Earth law, to get off this planet, now that intelligent life has been found. That would possibly work out all right with the colonists. From what Webster reported, the local intelligent life is so backward that an Earth colony would be welcome. We'd show them new techniques, bring in new plants and animals—everything. But the old idea the Company had is out; wholesale stripping of the planet of its natural resources."

One of the other colonists seated to the front of them looked back over his shoulder and queried, "I thought New Arizona was sovereign now that the Company's met all regulations. I thought the skipper and that there board made all the rules now."

Enger nodded. "That's the way it was going to be. But old Matthew Hunt when he discovered this planet didn't report there was intelligent life on it. That changes everything."

Ted Shackleton said, "You think old Hunt knew about 'em but just didn't report it? From some of the other things, he pulled—"

Enger said thoughtfully, "I don't know. Before he could claim the planet he had to do a certain amount of preliminary mapping and surveying. I read his reports. They told about quite a few of the animal life forms, even some of the sea life. I don't see how he could've missed anything that makes as big a mark as intelligent life. If they've got blowguns and darts, they must have fire. How can you hide fire?"

He came to his feet along with the others. The meeting was breaking up. Enger wandered over in the direction of the floater which had been attacked.

It was under guard and idle colonists interested in gawking were being sent on their way. However, Curro Zorilla, a stogie clenched in his perfect white teeth, was making an inspection and when Enger came up, nodded to him. That was enough for the guards, who had at first looked as though they were going to run the ex-board member away as well.

Zorilla rumbled around the cigar, "Some of this doesn't make sense." He handed Enger a very short, arrowlike missile. "What do you make of that?"

Enger Castriota was surprised at the man's easy acceptance of him. There seemed to be no change in attitude whatsoever. If anything, a certain higher degree of respect.

Enger scowled at the object. It was heavy, evidently bronze pointed, neatly feathered at the end. He said definitely, "This never came out of a blowgun. I thought Webster said they used blowguns."

Zorilla rumbled, "We questioned

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him on the ship, after Doc Miltiades tranquilized him a little. Evidently, they'd landed in a small clearing, only about forty miles north. They figured on hiking over to a nearby cliff where Fodor's instruments had indicated heavy iron ore deposits. They'd hardly got to the edge of the clearing before the Kogs hit them."

"The what hit them?"

Zorilla grunted, his eyes still going about the aircraft, even as he talked. He poked one of his thick fingers through a hole that had been torn in the side. "I don't know who started the term, but it's already going around."

"Minimize the enemy by giving him a contemptuous name," Enger murmured.

Zorilla looked at him. "The practice has been going on for a long time. The Greeks used to call anyone but Greeks barbarians, including those with higher civilizations."

Enger Castriota was surprised that Zorilla knew anything about the Ancient Greeks, but it was hardly the time to discuss history.

Zorilla rumbled, prying about the helicopter again, "Fodor got it first. A dart in the neck. At first they thought it was some sort of insect, or possibly a sliver out of some bamboolike plant. Their hesitating almost finished them all off. By just about the time they realized they were under attack the . . . Kogs came dashing out screaming war cries."

"War cries?"

"That's what Webster called it," Zorilla said. "They were evidently carrying knifelike hand weapons, blowguns, and what we'd call standards or totems, I suppose."

Enger was frowning at him. "Totems!"

Zorilla said, "All this is from Webster. The others didn't live long enough to talk. He said a couple of them were carrying big metal emblems that looked something like swastikas and that sort of thing. But most carried weapons."

The younger man was staring down at the dart in his hand. "Too small for an ordinary bow," he said. "And too clumsy and short to throw. You know what this is, Zorilla?"

The swarthy South American looked at him.

"It's a crossbow bolt. Webster might call them monkeys, but they've reached a rather high mechanical development."

Zorilla looked at that point of the clearing where the forest came nearest to Tent City. "They're only forty miles north," he growled. "We're going to have to send out the one-man floaters and talk all the outbackers into returning to the community."

"Outbackers?" Enger said.

Zorilla grunted sour humor at him. "For somebody who's now living in Tent City, you don't keep up very well on developments," he said. "Slang develops fast on a new

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frontier. The outbackers are those colonists who've taken off into the boondocks, some with their wives and families, some alone, to make their own way. Some must have left the first week the *Titov* landed. Since then, a day has hardly passed without at least one leaving. Sometimes two or three families take off in a group. Most try and convert whatever tradable possessions they have into weapons, tools, fishing equipment and possibly some agricultural necessities, such as seed."

"But they're under contract," Enger said.

Zorilla's expressionless visage broke into a rare albeit sour smile, barely discernible. "And how are you going to enforce them? That's one angle Matthew Hunt and the others didn't consider. What are you going to do, send Ben Ten Eyck and his bullyboys after them? Once caught, what would the punishment be? Shoot them, and precipiate an all-out fight with the other colonists? Or put them in jail—once we've built a jail. Put them in jail and you have to feed them, and we're short enough on supplies now. In the outback, they provide their own."

Enger said slowly, "Now that you mention it, I recall a discussion in the tent bar the other night. Somebody mentioned that a colonist had acquired an auto-plow somewhere and wanted to trade it for a gun and other equipment so he could become a . . . an outbacker."

"An auto-plow!" Zorilla exploded. "I thought we were missing an auto-plow. Where'd you hear about this romp, Castriota?" He threw away his stogie in disgust.

The other had to laugh in deprecation. "That's all I know about it. Evidently, he didn't find anyone who wanted to trade."

"By Zen, this damn colony will melt away through pilferage before we ever get going," the heavy South American growled.

In spite of the one-man floaters which beat the area for a hundred square miles, only a fraction of the outbackers who were located actually returned. A portion, evidently, believed the story of the Kogs to be a fabrication in an effort to get them to return to the jurisdiction of the Company. Another group minimized the danger of the natives—if natives they could be called—particularly those who had firearms. Still others, and particularly small communities which had put up log houses and got in a crop, agonized over abandoning the products of their heavy toil. They were prone to erect stockades around their houses, hoping either to be ignored or undiscovered by the Kogs, or of their superiority being so recognized that the monkey-men would be afraid of hostilities.

But some returned, a few shamefaced, and took up their places in Tent City that they had abandoned.

It was a week after the first at-

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tack on Fodor's floater that the stragglers began coming in with reports of Kog attacks and casualties being taken by isolated outbackers.

It had been a week of considerable change in Tent City. Somehow, the threat of danger had magnified the shortcomings of the community, rather than strengthening it. Elements that had in the past at least played lip service to participation in necessary labors, now malingered without bothering with alibis. The dance hall cum bar, that had surprised Enger Castriota by its very existence such a short time before, was augmented with half a dozen more of the same, varying in size and the refreshment provided.

And it was at the end of the week that Enger Castriota was summoned by the colonist committee. It was meeting now in the Administration Hall which had been erected with the first lumber that had been produced by the new small sawmill and drying kiln. The machinery for this had been improvised largely through the efforts of Jeff Ferguson, working in the colony's new machine shop, and those of several of the more enterprising residents of Tent City who had had past experience in the field.

There were the three doctors of the original committee and Cathy Bergman. The latter was looking considerably less the carefully groomed young lady she had during the trip on the *Titov*, and much more like the overworked colonist performing labors others could have handled had they the desire.

There were also eight others, four men and four women, elected from what divisions, Enger Castriota didn't know, though they seemed to represent most of the basic fields of community endeavor. Ted Shackleton, he noted, evidently spoke for the commissary.

He hadn't the slightest idea of why he had been called before this improvised body which, actually, held no legal position on New Arizona and was unrecognized by the Company. So far as he knew, it was a body with a voice but no powers to enforce even its most piddling decision.

Hugo Miltiades, whose seniority in age evidently was deferred to, acted as spokesman. Like the others, his voice denoted his weariness. Those who carried on the tasks necessary to keep the community of Tent City a living organism had, through necessity, assumed the duties of their fellows who had become parasites. No other way had been figured out; the work had to be done, or all went under.

Miltiades said, "Without preliminaries, Citizen Castriota, we would like you to assume the position of town police officer. You would have two assistants."

Enger, with obvious surprise, said, "Police officer! How about Ben Ten Eyck and his men? He must have at least a hundred armed police."

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Somebody grunted scorn, but Miltiades only shook his head.

"There are police and police, Citizen. Those under the command of the *Titov's* former chief officer are instruments of the New Arizona Company and interested only in preserving the prerogatives of that organization."

Enger said in what he thought all fairness, "They're also out there protecting us all from the Kogs."

Cathy said, "Isn't it obvious that they can't protect themselves without protecting us as well? The Company didn't bring along two thousand colonists because it loved us, but because it had to. If it could dispense with us all, it would."

Miltiades said, "Let's try to make this brief. Ten Eyck's men don't police Tent City. In the past week, we have had four deaths, various robberies, and several hospital cases of badly beaten men. We need a police. You are not under contract, and hence not forced to participate in the labor drafts—"

One of the committee chuckled without humor. "Even if they caught him in one of Ten Eyck's requisition gangs."

The doctor went on. "Your physical abilities have become known. We can think of no one better to take over the task."

Enger hesitated. He knew of the nightly fist fights, knife fights and the shootings that had taken place in the boom town's bars.

Cathy said quietly, "It's a job that has to be done by someone. And it's a man's job."

He mused, "I suppose my men and I would be issued firearms."

Miltiades shook his head. "The Company has ordered confiscation of all such weapons save those in Ten Eyck's forces. In the name of emergency, it has become an offense to have one."

Ted Shackleton said to him, grinning, "A stute like you doesn't need no gun, Enger. Just pop their ears."

Enger Castriota grunted and looked at Cathy. She was watching him, her lips slightly parted.

"All right," he said. "I'll take it." And then something that meant nothing to any of them save the girl. "It's one thing I have training in. I'm duty bound to use it."

He knew he had taken on a task. The worst elements in the community had grown strong in the confusion of the threat of attack. Work had slowed off on the few serious projects the colony had thus far gotten under way. What little direction had formerly come from the officers of the *Titov* and from the Company board, now all but disappeared leaving Tent City and its occupants on their own. Save for Curro Zorilla, and his basic interest in the agricultural development of the planet, it was seldom that a colonist even saw their supposed leaders.

It was rapidly becoming a matter of each man for himself and let the strong take what he could hold.

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Supplies were running short, rationing was already the order. The colony was largely dependent upon the skill of the hunters and fishermen who still daily went into the woods.

For Samuelson had been wrong. The threat of the Kogs hadn't kept the woodsmen from providing meat and fish for the colony. In fact it had, if anything, increased their efforts. It was one of the few tasks that could be carried on profitably on New Arizona. For the supplying of meat had ceased to be a community affair, once it had become dangerous, and those that now went into the forests did so with profit in mind, the bartering of their products of the chase for superior food, clothing, tools, geegaws, liquor .. . . and the more available of the women who hung about the dance halls.

Many of the outbackers, who had returned to Tent City for its supposed protection, had become hunters having acquired in their short weeks in the outback a knowledge of the woods and lakes beyond that of those who had remained close to the *Titov*. And many of these, Enger knew, were the toughest elements he was going to have to contend with.

The first night was going to be crucial. He would either establish respect and authority, or it would be the end of the idea of a town police force. And there were elements, he knew, whose long-range plans had no place for such a police. Such elements as those who had discovered a local weed which, when dried and smoked, resembled *Cannabis* more than it did tobacco. Their profits were already astronomical, in the barterable effects that circulated about Tent City.

His two assistants, brothers, and both husky lads in their mid-twenties, were astonished at his rejection of their idea that the three of them patrol, particularly this first night, in a group. That the three stick together and take what came.

Enger shook his head. "We'll get the committee to assign us a small tent, in lieu of a jail. You two will guard it, Jimmy and Ed. I'll patrol. I'm the one the cloddies want to prove a funker. We'd only be postponing it if tonight we didn't allow those that want to make the try to take me on."

He had armed himself with an improvised baton about three feet in length and cut from what the community's lumber workers had already dubbed an *iron tree*, the wood of which was almost the hardness of metal. It was slightly more than the thickness of his thumb and there was a small knob on one end. It looked innocently like a walking stick.

The most popular hangout of the evening in Tent City was still the dance-hall tent which Ferguson had taken him to the night of the mob attempt to attack him. Now named the First Chance. Having got in on the ground floor, it had an advantage over its competitors. Enger

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chose that as his first destination.

It was as crowded as it had been on his first visit but he noted various changes. The bar, for instance, was considerably more elaborate and evidently had a selection of potables for sale, rather than just the berry liqueur. The band was smaller in number, now, only four pieces. Enger suspected that competitors had lured the other musicians away.

There seemed to be a new system of payment, too. At the end of the bar was a small booth in which one of the owners sat and issued credit slips for the objects being taken in for barter. Slips would be issued for one, two, or as many as ten drinks. Evidently, all drinks cost the same, one slip, and a bartender issued slips as change when one was proffered valued at more than a single glass.

Enger grunted inner amusement. A first, simple money was developing, based on alcohol.

The exchange booth was overflowing with the wide variety of objects brought in to trade for liquor. Various minor tools, tinned food, a camera, some books, a painting which had obviously been done here on New Arizona, sacks of what was obviously fresh meat, at least twenty empty bottles; it went on and on. There were few things brought over-space that were thrown away in Tent City. Everything had value, even empty tin cans, and, evidently, sooner or later almost anything that had exchange value crossed the barter counter of the First Chance.

Enger Castriota had no intention of trading away any of his meager possessions for the sake of a few swallows of the rot gut passing for liquor on New Arizona. However, it wasn't necessary.

When he had entered the noisy shelter there had fallen a momentary silence. The word had obviously gone around of the colony's new three-man police force. Then there had been a whispering buzz for a few moments, while Enger looked about, affecting unconcern.

Someone from toward the rear called out something obviously meant for him, and others had laughed nervously at the sally. The dancing had never stopped and now the volume of chatter, shouts and laughter resumed to the point it had reached before his entry.

Swinging his baton gently, he moved in the direction of the bar.

He hadn't noticed Leslie Darleen until that sardonic one called out, "Howdy, Sheriff, caught any rustlers?"

Enger came over to him. His desire was to smile ruefully and answer the other in like manner, but he was too new at his game tonight. He couldn't afford to lower dignity. A colonist, more than usually ragged and dirty, snarled something at his approach and scooted away to make room at the bar.

Leslie, dressed a bit less ostenta-

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tiously than had been his wont on the *Titov*, was leaning in nonchalance against the bar, sipping from time to time from an elegant glass which Enger suspected must have been brought from the spacecraft by Darleen himself.

Enger Castriota said, "You'll want to watch yourself, Citizen Darleen. I was mobbed here one night—in the belief I was a board member."

Leslie smiled mockingly at him. "Probably a difference in our approach, my dear Enger. First of all, I periodically buy a round of drinks for the house. And second"—he tapped a holster on his hip—"I carry the ultimate answer to all argument. I have a blaster, they haven't. And, thirdly, there's always the realization that if someone hurts me, *he's* in trouble. But if, for any reason, I hurt someone, the highest authority on New Arizona is in my pocket. I'm a member of the board which governs the planet."

He had bought a bar slip from his pocket. "A drink, Sheriff? What'll it be?"

Enger shrugged. "Some of that berry liqueur. You've made one mistake, Leslie. Now that other intelligent life has been discovered, Matthew Hunt and his company no longer own New Arizona, and by Earth law no longer governs it."

Leslie chuckled. "My dear Enger, you fail to give our diabolically clever Captain Gluck his due. It's all in the manner in which you interpret the term intelligent. The captain, lacking experts in the field, has taken upon himself to rule that the Kogs are not intelligent. They are predatory animals which the New Arizona Company feels it must be defended against."

It was a new development and Enger Castriota scowled as he followed out the ramifications. The bartender came up with a glass, pushed back the credit slip Leslie had turned over to him.

"The law's always on the house, Citizen Castriota," he beamed. "My name's Lefty. I'm one of the three owners. You won't have no trouble here, Citizen."

Enger shook his head. "Thanks just the same, Lefty. No freeloading for me." He smiled to take the edge off his words. "It'd put me in a bad spot the first time I had to crack down on something you and your partners were doing."

Lefty said, hurt, "Zen, we're not drivel-happy. We don't want no trouble with the committee's lawman. All we want is to make a good profit in this here business."

Enger nodded understandingly. "Then I'd take some kind of steps to stop the smoking of weed on the premises, Lefty. I can smell it all over the place. Doc Miltiades and the committee take a dim view of the stuff. They're going to pass some sort of ordinance, as soon as they get around to it."

Leslie pushed his credit slip back

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to Lefty again. "Very sound stand," he drawled. "No free drinks, no ties. But you'll never get rich that way, Sheriff."

The bartender poured the reddish drink and ambled off, shrugging, whether or not to do something about the narcotic, Enger didn't know.

The new police officer said, "Getting rich isn't the big problem on New Arizona these days. Staying alive is."

"Not always mutually exclusive," Leslie said, pursing his lips. "I came here to make my fortune, Enger old boy. So, probably, did every other passenger on the *Titov*." He looked from the side of his eyes at his younger companion. "With the possible exception of you. I can't figure out why you came, you don't seem overly ambitious. In fact you don't even seem an exponent of free enterprise. A veritable latter-day Marxist."

"What's a Marxist?" Enger asked.

"Haven't you ever heard of a man named Karl Marx?"

"No."

"At one time, half the world thought he was possibly the greatest genius the race had produced, the other half thought him the greatest villian."

"Well, who was right?"

"Neither, of course," Leslie said reasonably. "He was a Nineteenth Century political economist who analyzed the socio-economic system and concluded it could prosper only so long as it could continue to expand. He had hard luck. In 1848 he wrote his pamphlet the 'Communist Manifesto', predicting a collapse. However, next year gold was discovered in California and the world economy got a shot in the arm. So he revised his opinions but still figured the economic collapse was in the near future, when capitalism could expand no longer. But by the time things were overextended again, the First World War broke out and half of Europe was blown to smithereens. It took about twenty years to patch it up, and then the Second War broke out, keeping everything working at capacity again. When that was over, there was a big arms race between those who played lip service to the old boy and his detractors, and that kept things expanding. By the time that began to be insufficient to keep the socio-economic system expanding, we began to explode into space and now there's more room for expansion than ever." Leslie chuckled sourly. "So the Marx-foreseen day when capitalism would reach the point where it could expand no longer and would hence begin to atrophy, never was reached. Free enterprise is still largely in the saddle. At least it is on Earth and most of United Planets. There are some far out exceptions."

Rog was looking at him skeptically. "Did anybody named Marx really live?"

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Leslie shrugged. "I don't know. I read a brief article about him once. If he did, what he taught has been lost in time, translation and distortion, all of which began before he was cold in his grave. I have a theory that the supposed followers of religious and socio-economic leaders distort the teachings of their prophets to a greater extent than do their enemies. I'd give a pretty to know what the Buddha really taught, or Jesus—before their one hundred and one warring sects got hold of the spoken word."

The new police officer sent his eyes around the tent again. Other than the smoking, there didn't seem to be anything going on that called for his presence. He might as well visit some of the other establishments of the evening.

He was premature. Hardly had he finished his drink and begun to turn to Leslie Darleen to thank him and bid him a good evening, than a bearded colonist who hadn't bothered to change from the clothing he had obviously worn into the woods that day, staggered up, a home-rolled cigarette in his left hand and narcotic evil in his eye.

He stood off about six feet and let his eyes go up and down the length of Enger Castriota. Of a sudden, there was plenty of elbow room. The bar, a moment ago so crowded that a newcomer had to buy his drink over the shoulders of earlier comers, was suddenly free for a good ten feet or more to each side of where Enger and Leslie stood.

"Oh, oh," Leslie said mildly. However, to Enger's surprise the dapper hedonist made no effort to move.

The outbacker, or hunter, or whatever he was, had a blaster rammed into his belt, but for the present made no move toward it.

Enger Castriota shifted his grip on the baton, infinitesimally. He could feel moisture coming to his palm.

A hush had fallen over the whole tent, even the raucous music had fallen away and the dancers came to a halt.

Silent, the two watched each other. Enger leaned on the bar with his left arm, his right holding the canelike stick nonchalantly. It was an innocuous looking weapon. It came back to him that of all the combat training he had undertaken as a youth, that with the riot stick had seemed least useful to him. A maternal uncle had insisted, it being his particular hobby. Uncle Josip had had a multitude of stories of the British yeoman and his quarterstaff, of the ancient Buddhist monks who had carried the equivalent on their lonely wanderings through Asia, of mob control police of the Twentieth Century who had depended upon it.

The other's eyes shifted from left to right, taking in his nearest neighbors. His mouth worked. He was

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getting ready, Enger realized, to make his play. His motivation? Who could say? Under the combination of weed and bootleg drink, perhaps no motivation was needed.

Leslie said lazily, "Sheriff, I suggest you inform the yoke that he should get off the pot if—"

The woodsman's hand snaked for his belt, and he went into a half crouch.

Enger moved forward, his right leg bent at the knee, his right hand grasping the baton and extending it as though he were fencing with a rapier. He made no attempt at hitting the gun, nor any particular point of wrist or arm. He banged instead the forearm, at random.

He moved fast now, without waiting to see if the other was disarmed. The woodsman was a good fifty pounds heavier, and hardly seemed fat. In fact, the inactivity of the time on the *Titov* and even here in Tent City had left Enger Castriota flabbier than he had ever been in his life. The next split seconds were going to be crucial.

He stepped forward with his left foot, even as he saw the other fumbling toward the floor to recover his gun. He heard Leslie, from behind him, excitement for once in his voice, call something as though in warning, but he didn't make out the words over the sudden roar of the crowd, now that the action was joined.

He stepped forward with his right leg, reached out quickly and grabbed the woodsman by the right shoulder and pulled him forward and to the left sharply. The baton came around, low and as hard as he could strike, cracking the other in the big muscle of the calf.

He heard a roar of anguish and inwardly winced for the other's agony. Uncle Josip, in his instructions, had seldom pulled punches. Such a blow, Enger knew, led to immediate leg cramp of the most excruciating kind.

He stepped back quickly to review the situation. His man was down, but he didn't know what friends the other might have in the crowd, nor did he know where the blaster had landed.

He located it a few feet from the fallen woodsman and scooped it up. Cupidity would have motivated him to stick it in his own belt, it being the single most precious item on New Arizona and barterable anywhere, no matter Ben Ten Eyck's orders that all firearms must be turned in.

But long term prudence dictated otherwise. He shot the clip, emptied the charges into his hand, banged the empty magazine back into the weapon and tossed it down beside the vanquished.

He turned back to the bar and said, trying to keep his voice even, "I'll have that drink, Lefty."

Lefty came scurrying up. "Yes, sir, Sheriff—" The little bartender had picked up Leslie Darleen's title of derision.

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While the drink was on its way, Leslie said mildly, "Aren't you going to run into difficulties with our good Ben, if you don't confiscate that firearm?"

Enger said quietly, "If Ben Ten Eyck wants to confiscate blasters, that's his worry. My job is to keep peace here in Tent City. That man there probably needs the weapon for hunting, and Zen knows, we need good hunters."

"Amen to that, Sheriff," Lefty told him. "That Barney's one of the best men we got going into the woods. Just a little bad when he's high on weed, is all."

Enger finished his drink and said calmly, "He won't be able to walk for a few hours. Let his friends take him back to his tent. He'll be O.K. in the morning."

He turned, preparatory to leaving, and said down to the fallen and moaning hunter, "Barney, don't ever let me see you smoking weed again, understand?"

Leslie said, "If you don't mind, Sheriff, I think I'll follow you along. On the face of it, the action in town tonight is going to be in your vicinity."

"Don't call me Sheriff," Enger growled at him. He was having the first symptoms of aftermath now, and wanted to get out of the tent and the view of Lefty and his customers before his hand began to shake, or he otherwise displayed actual lacking of the calmness in combat he had projected.

X

He might as well have accepted the label Leslie Darleen had hung on him with good grace because it caught on immediately. Few there were in Tent City who hadn't watched historical romances, including Westerners, on the Tri-D. The office had disappeared long years before, but the term Sheriff was still in the language, and nothing would do but that Enger Castriota carry the title. If they'd had a star, they probably would have insisted on pinning it to his jerkin.

The balance of the evening had gone considerably easier than he had at first expected. Perhaps his initial success set the key. His success and the manner in which he had handled it.

It had been a stroke of luck on his part, not to have taken Barney the woodsman's weapon. It labeled him, as nothing else could have, an adherent of the colonists of Tent City, not a tool of the Company. Every blaster the colonists still retained was worth more than its weight in the most precious of commodities. Not only for the defense, but for sustenance. Already the word was going round that the board members and the crew were cutting down on the supplies being issued to the tent town, both in quality and quantity. Those who based themselves in or about the *Titov* still ate adequately. Tent City was strictly rationed and without the

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help of the hunters, fishermen and gleaners of such fruits and berries as the forests offered, would have been desperate.

Every firearm was needed and the so-called sheriff had put himself on record in leaving Barney his, in spite of the other's attack on his authority.

Evidently, the gossip spreaders had hurried ahead of Enger Castriota as he made the rounds of bars, dance halls and gambling tents, because as Enger and Leslie entered each in turn they were received with acclaim. Only once was he called upon again to exercise violence in defense of his position.

A drunk, so far gone as to be on the verge of passing out, had decided to whip the new police authority. Enger considered briefly escorting the other down to the improvised jail which his assistants, Jimmy and Ed Brunner, were guarding. But he decided against that. It would be a mark in his favor if he was able to handle this first night without any arrests whatsoever. It would at least indicate that he wasn't a power-happy flat with delusions of grandeur about his new appointment.

He compromised by poking his riot stick sharply into the other's stomach, causing that pathetic soul to double up, his face to go green, and to be led out quickly by a companion to empty his roiling stomach in the alley back of the bar.

In this establishment too, the house had offered him a drink.

"You take it," Leslie said sourly, "at your own peril." Leslie Darleen was evidently an authority on nightlife in Tent City, such as it was.

Enger, if for no other reason than curiosity, took a healthy gulp. He hesitated a moment, wondering at the advisability of spitting the stuff out again. He swallowed instead and looked at the bartender accusingly. This was the smallest and newest of the bars, without music, without dancing, and without the women which teemed in the other places.

He looked accusingly down into his glass. "What in Zen do you make this out of—and why does anybody drink it?"

The lone bartender was defensive. "Some folks can afford to trade off all their things for that expensive guzzle they got at the First Chance. This place of mine is the cheapest in town."

The small crowd of customers laughingly backed up the new sheriff in his condemnation of the quality of the drink.

Enger repeated his question. "What do you make it out of?"

The other shut his mouth, stubbornly.

Leslie Darleen chuckled wryly. "You know what it tastes like he makes it out of."

One of the customers said, "I know one thing he puts in it, frozen

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grapefruit juice, cause I bartered it to him."

"And raisins," somebody else said. "Just about anything that'll ferment."

"Known to history," Leslie drawled, "as jungle juice. Guaranteed to pop the top off your head, comes morning."

Enger said coldly, "And guaranteed to use up colony supplies."

The bartender whined, "Aw, nobody wants the stuff I put into my vat. Who drinks grapefruit juice?"

"Kids do," Enger told him coldly. "Youngsters with certain vitamin needs we haven't figured out how to meet on this planet as yet. Look here, I've been appointed to keep the peace, not to crack down on new business ventures. However, I suggest starting tomorrow you find some other something to make your jungle juice from, something native to New Arizona. If you don't, I'm going to be keeping an awful lot of peace around this tent. Understand?"

"There ain't nothing else to use," the other said stubbornly.

"The First Chance figured out using berries," Enger said.

"Yeah, berries. But I don't have nobody on the *Titov* to go steal a deepfreeze for me, like that Ferguson guy."

"Don't tell me your troubles," Enger told him definitely. "I've got my own."

When they left the tent, Leslie Darleen looked at him in amusement. "Sheriff, you were made for this job. You've been keeping your light under a bushel, or however the expression goes."

Enger grunted, then turned on the other, looking at him. "Isn't there anybody at all in the whole colony that's out for the community as a unit, except Cathy and possibly the doctors?"

"Oh, don't get the wrong idea about the doctors," Leslie told him, twisting his mouth. "What do you think they came to New Arizona for? Given a successful colony here and they'll have it made beyond the point of the legendary Mayo Brothers. By the time any other doctors come out here—if they ever do—Miltiades, Kelly and Flo James will already have such a monopoly that they'll take on the newcomers as interns in their private hospitals."

Enger was scowling at him, even as they walked toward the tent where he had left his two assistants. "What do you mean, if they ever do? Of course more doctors will come out."

Leslie Darleen's voice left some of its humor behind. "Don't be a flat, Sheriff. The chances of New Arizona being anything except a desert five years from now are remote. The board's original plan might have been to sell a few concessions for enough to finance thoroughly exploring the planet's remaining exploitable natural products and then to sell these more

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selectively. Such a thorough exploration would have taken time and involved a number of engineers and technicians. But the way things are developing, the skipper is getting his wind up. My guess is when he figures out a way of communicating with Earth, he's going to try and peddle the whole planet, lock, stock and barrel in a lump. The sum involved will be a fraction of its worth, but it'll still mean a fabulous profit to we on the board."

Enger said in objection. "The colonists aren't going to stand for that."

Leslie chuckled tauntingly. "And what are they going to do about it? Send their new sheriff to give the skipper a bad time? Begin to think of yourself, Enger. The board controls the ship and all the supplies on New Arizona; it controls practically all the firearms; and above all, it controls a small army of some one hundred men, the former crew and various heavies recruited from the colonists themselves. That army has been promised a slice of the cake. Perhaps a small one, but still a slice that will make every one of them wealthier than he'd ever dreamed. You could climb on that bandwagon, too. I'm sure Ben Ten Eyck would find you a job equivalent to an officer's rating."

"I've got a job," Enger Castriota muttered.

Leslie Darleen laughed at him. "You prefer the colonists, eh? With what coin does she pay off?"

"What're you talking about?"

"Why, our dark beauty, Cathy, of course. But then, as a gentleman I suppose I should keep the rumor I've heard to myself."

Enger stopped, scowling, and turned to face the other. "What are you talking about?"

Leslie chuckled slyly, and there was an amused quiver of his soft, full lips. "Don't be coy, my dear Enger. It's gone around that you sometimes share a tent."

Without thought, Enger Castriota's hand lashed out and slapped the other stingingly.

The raid came a few days later and its initial fury was such that it carried everything before it.

It was noon and Enger Castriota was making his first patrol of the day. Cathy Bergman, for once having found a few hours of rest, was strolling along with him.

The greater part of his duties were at night, but he and the Brunner brothers had adopted a policy of letting themselves be seen during the day hours as well. The amount of pilfering and most certainly more serious robberies had fallen off drastically. Before their appointment as police officers, crime had become so prevalent that the only law was that of the jungle. The strong took what they would from the weak and there were none to say them nay.

Refining of law on New Arizona was going to have to await such

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institutions as judges and court—and a jail that provided a bit more strength than cloth walls. Meanwhile, Enger and his assistants improvised. Their lockup being meaningless, punishment took the form of an immediate physical thing, which had set habitual petty criminals back on their heels, since such crime as there was had no organization. Enger, Jimmy and Ed worked singly or together to physically conquer their malefactors, or, if outnumbered, called upon nearby colonists to give them a hand.

It was, Enger Castriota realized, little more than lynch law. The baton-armed police officers were judge, jury and corporal punishers. And it bothered him. He could only tell himself that this was the frontier of which he had always dreamed—somewhat inaccurately. That the nearest thing to a democratic government was the committee and that committee had appointed him and the Brunners to keep the peace.

And then, deep within, reason told him that the committee had no real position whatsoever on New Arizona. That the New Arizona Company embodied the law, and he had no recognition from the Company. When he broke the jaw of some poor belligerent drunk with his baton, no real authority gave him the right to do so.

The justification of his position went round and round in his head, every time he tried to think it through. But he continued at the job, and if there is anything at all in the contention that the ends justify the means, petty crime, at least, all but disappeared.

Cathy was pointing out new developments. At this stage of the game, no matter what the conflicts between colonists and Company, and between humans and so-called monkey-men, Tent City was altering its face all but daily. Indeed, its name, before too very long was going to need change. Wood was replacing cloth textile in its material, and even stone and concrete were beginning to make themselves evident—Fodor having discovered some accessible limestone-like deposits before his demise. Beyond the reaches of the original hurried settlement were going up a score of buildings, farm, residential and community. Things might have slowed since the danger of attack, but they certainly hadn't stopped.

Cathy pointed out a new structure that Enger Castriota hadn't noticed before.

She laughed quietly. "That Jeff Ferguson is incorrigible. I sometimes think that half the progress made in this colony is due to his drinking."

He had to laugh in return at that. "What are you talking about now?"

"That building there. It's to be a windmill. Have you noticed that constant wind from the south? Jeff is harnessing it."

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"What's that got to do with his drinking?"

"The power pack for the deep freeze which makes his favorite drink has about worn out. The captain won't release further power packs for the colony, so our stute Citizen Ferguson is rigging up a generator in the town's machine shop. Happily for we colonists, he's the only real engineer aboard that is truly familiar with the *Titov* and all its equipment. He has the use of the tools, and evidently pilfers whatever else he needs to accomplish his ends."

"The Third Engineer, Ed Murano, is supposed to be a good man," Enger said.

"But he's completely tied up with Ben Ten Eyck's security force," Cathy nodded. "He had no interest in Tent City and its workings."

They had come to a halt beyond the reaches of the town proper and looked out over the fields.

He was fully conscious of her nearness, and the realization that they were beyond the earshot of anyone who might have listened to their conversation as they walked through town.

He cleared his throat and began to say one thing, but another came out. Enger Castriota wasn't as experienced with women as all that.

He said, "What're those wooden buildings, there?" And the moment after realized that he knew the answer, and that she knew he did, since they had been discussing Curro Zorilla's projects only the day before.

She looked at him, and the left side of her mouth quirked. "Why those are Curro's animal pens. One of his porker sows—if you can call them that—had a litter this morning. Zen! sixteen of them. Real pigs don't have that many, do they?"

"I don't know," Enger said. "How's his milk goat going?"

She knew he was making conversation, desperately, and the idea seemed to please the perverse in her.

"The little goatlike thing? Curro says it will take quite a few generations to even know whether or not it will work out. He's in favor of importing Earth-side cows."

Enger said thoughtfully, "He doesn't seem to be working on the theory that New Arizona will be a desert in five years."

She looked at him. "Curro? He never did. Curro came here to found a family and a home for the generations to follow."

A horrible thought came to him and his voice tightened. "Curro?" he said. "You seem to be awfully friendly with him all of a sudden."

"Oh, it's not all of a sudden, Enger. We've had mutual ideas from the beginning. He's the only one on the board who almost consistently votes the way I do."

He swallowed and tried to keep his voice even, but the words were bitter. "And you say he's looking

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for a . . . well, for a wife, I suppose, if he's going to raise a family here."

She looked out over the fields and smiled sweetly. "Oh, no, he's not looking for a wife. He's found her." She didn't go further.

He looked at her, finding meaning in the words.

She added nonchalantly, in mercy, "In fact, I'm to be her bridesmaid at the wedding, as soon as Pater William's temple is finished." But after dropping that relieving bomb she frowned and said, "What's that going on there? Over at the woods."

He had to tear his eyes away from her to where she pointed.

Half a dozen men streamed out of the forest. From this distance, he couldn't be sure, but they looked like hunters. They must be hunters, two carried what looked like blaster rifles, one a bow and quiver of arrows. Some of the men who hadn't firearms had been experimenting with archery lately, not too successfully thus far.

They were turning their heads to look behind them, periodically, even as they ran. And finally one stopped, turned, leveled his blaster and fired back into the woods, turned again and continued his flight.

Three more men debouched from the woods, two carrying the third. At a point a quarter of a mile to the left, two more men darted from the trees and, crouching low, sped in the direction of Tent City.

Enger Castriota spun around, cupped his hands to his mouth and shouted at full volume, "Raid! Raid! The Kogs!"

He snapped to Cathy, urgently, "Get to the fire siren in the Administration Building. Quick! Maybe nobody else will think of it. We should have planned for this a long time ago!"

More of the former outbackers and huntsmen streamed from the woods, some of them obviously fighting a rear guard action. Stopping, turning, firing back the way they had come. Some limped, obviously wounded. Some, like the trio earlier, were helping others. There were two or three women, one half dragging, half carrying a six-year-old. One unarmed woodsman ran twenty or thirty feet from the shelter of the trees, pitched and fell on his face and made no effort to move further.

Enger Castriota began running in the direction of the developing fight.

"Where are you going?" Cathy called after him.

"I don't know," he shouted back. "Get to the siren."

Even as he ran, he could see that possibly twenty of the colony's woodsmen had emerged from the forest in all. They were still retreating fast, but now out of the trees they seemed to work more in con-

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junction, co-operating in making the retreat more orderly. Those who were wounded, or supporting wounded comrades, continued on toward Tent City. The dozen or so remaining, covered by six running a hundred feet or so, turning and flopping to the ground to fire into the woods. While they fired, the other half dozen would scramble erect, run, and then turn and flop down in their turn.

From the side of his eyes, even as he ran, Enger could see others coming up. A dozen of Ben Ten Eyck's security men, running at the double. Another group, all carrying farm implements of the pitchfork, hoe and ax variety, erupted from the wooden shacks that composed the animal-breeding buildings and dashed toward the developing fray. He could make out Curro Zorilla, what looked like a sporting shotgun in his hands, leading.

Enger Castriota came up on the trio, two of whom were carrying the third.

"What happened?" he demanded.

The wounded man was the one they had called Barney. The black-bearded hunter whose blaster Enger had refused to appropriate the night the man had attacked him in the First Chance.

"The Kogs jumped us," one of the others told him. "Hundreds of them."

"Thousands of them," Barney grunted, twisting his face in pain. A crossbow bolt was still stuck in his leg. "They've burnt every outbacker's place for twenty miles out, at least. Killed everybody."

Enger looked up toward the forest, four or five more colonists had come stumbling out of the trees, running desperately, making no attempt to return fire. And even as he looked, the first of the Kogs appeared; screaming, darting little figures, wearing only semblances of clothing. Largely, they carried six-foot long blowguns, but he could make out what must be crossbows, as well. They emerged from the woods in several groups, each of about one hundred and under little discipline, if any.

Enger snapped, "Leave Barney here. You two get back into the line. Give me your blaster, Barney, and what ammo you have left."

One of the men growled, "Barney ain't giving his blaster to nobody. A blaster on this planet's the difference between—"

And the other was saying, "We're taking him back to the hospital. He saved my life."

Enger snapped, over their protests, "Every firearm's needed, and every man that can fire one. Leave Barney here. There'll be unarmed people coming up shortly. They'll take care of him."

Barney bit out, in pain, "Give him the blaster. He'll give it back." He grimaced and muttered, "He give it back once before."

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Enger snatched up the hand weapon and without waiting to see if the others were accompanying him, started for the fray again. His eyes went to the nearest pillbox, at least two miles toward the lake. It was far from the scene of immediate action, and still not quite finished. Even as he watched, two or three more of the hundred-groups Kogs emerged from the forest nearest that strong point and washed toward it.

They'd be getting no support from Ten Eyck's men based there.

He could hear the woodsmen who had been carrying Barney pounding along behind him. They came up to the stone work of a well that some of Zorilla's farmers had sunk, for what purpose, Enger wasn't sure.

He halted, though they were still half a mile from the front line of skirmishers, and said, "You two stop here. Dig yourselves in."

"The fight's up there!" the argumentative one growled.

"It'll be here before you know it," Enger snapped back at him. "You're tired. Catch your breath, so you can fire accurately. Dig in and this'll be a strong point by time the fight gets back here. You've got rifles and can knock them off at a good range. This hand blaster of mine has to be closer." Once again, before waiting to find if he was being obeyed, he ran forward.

Still more of the caricatures of men were pouring from the forest in their mobs of a hundred or so, but the retreat of the colonists was not so precipitate. The siren was screaming back in Tent City and a squad of Ten Eyck's security police was coming up fast from the right where they had been stationed in the vicinity of the residences being built for board members and the officers of the *Titov*.

The sounds of firing were distinct now and the shouts of the Kogs. The monkey-men, who had a respect evidently for the firearms but not a complete fear of them, were slowing down a bit in their rush. Their crossbowmen pressed to the fore, having a greater range than their blowgun bearing fellows.

As Enger got nearer, he could make out what Webster, the pilot of the floater in which Fodor and MacDonald were killed, had called the Kogs' totems. Every group carried at least one and they consisted usually of either a swastika or a monad emblem; beaten out, from the looks of them, from either gold or highly burnished copper.

And further back, not far from the woods, was a platform borne by four of the small figures and supporting what seemed a phallic symbol. Enger Castriota's face worked in surprise when he saw it, but, running doubled up now, as men run when in fear of being hit by missiles be they arrows or bullets, bolts or shrapnel fragments, he approached the ragged scattering of colonists and crewmen who

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were still in full retreat but beginning to form a more disciplined line.

He flopped down next to Curro Zorilla, behind a slight rise. The South American's face, for once, carried expression. It was fury.

He shot a look sideways to see who it was, took in Enger and the handblaster he carried. "They're trampling down the maize," he rumbled furiously.

Enger could have laughed hadn't he, at the same time, seen the hordes of brown Kogs flow over a small group of wounded colonists who had evidently come to a halt in despair and turned to fight it out, too exhausted with their wounds to go farther. There was a hacking of machetelike knife-swords and screams of triumph, and then they were coming on again.

Zorilla looked at Enger's blaster. "Can you use that?"

"Yes."

"If you can't, get it to somebody else. Every firearm's needed."

"I was top marksman at the university," Enger said, without looking at the other. "They had a club that made a hobby of firing just about every weapon man's used down through the ages."

Zorilla grunted, as though in contempt, but he said, "Come on, let's get closer. This sporting shotgun of mine won't reach any farther than your hand blaster. The boys with rifles can afford to be farther back." He came to his feet and, running as Castriota had a few minutes earlier, hurried toward the hottest action. Enger followed, his throat tight now. They were coming up on what must number at least a thousand of the kogs, and more emerging from the woods by the minute.

Opposed to the natives were, by this time, possibly a hundred colonists and crewmen, but more were streaming up from Tent City, singly and in twos, threes and fours. No attempt was being made at discipline or co-operation in action, until the fighting front was reached. Even then, no orders seemed to be given or taken in an over-all sense. Nobody was in command. Other than the comparatively well disciplined security men, fighting under officers and noncoms from the *Titov,* it was each man for himself.

And yet, they instinctively cooperated. Their line was fairly straight, and the shouts of the Space Forces trained ship's officers for them to spread out so as not to present a bunched target, were surprisingly well obeyed.

Even as he and Zorilla passed the line proper and pressed nearer to get their short-ranged weapons into action, Enger realized why colonists and crew were instinctively fighting so well. In the knowledge of all, it must have been clear that this was it, that they were in the clutch. That all bets were down. The Kogs were in

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overwhelming number and the Earthlings had brought naught but sporting arms from the home world. They could never stand the onslaught.

Half a dozen modern combat weapons of even the simpler sort, and the trained Space Forces veterans could have swept the field clean. But there weren't half a dozen modern weapons, nor even one. The blasters they bore were meant for animals seldom larger than mule deer, nor were they even fast firing. The hunter doesn't waste ammo or meat on automatic weapons.

Curro Zorilla sat down suddenly and rested his elbows on his knees to steady his shotgun. Enger plopped down beside him, took a similar position, and held the pistol double handed. He had never fired this particular blaster before, but its workings were obvious. He aimed indiscriminately at the close packed enemy and pressed the trigger until the clip was empty.

He had taken two extra clips from the wounded Barney. Now he shot the empty clip from the gun's butt, let it drop to the ground and banged one of the fresh ones into place. Beside him, Zorilla was reloading his shotgun.

"Bird shot," he complained in agony. "Back on the *Titov* I've got one of the best big game blasters ever made and here I am with a gun I brought out today with the local equivalent of duck in mind."

The screaming mob of little brown Kogs was within fifty feet now, and there was the rushing of air above them that denoted the passing of crossbow bolts and the hissing of what must have been blowgun darts.

"Let's get out of here," Enger rasped.

They jumped to their feet and running bent double again, beat for the rear. Enger felt his jerkin rip as a bolt missed his flesh by millimeters. Fifty feet back, and they plopped to the ground once more. For the moment they held their fire, both to catch their breaths and to allow the Kogs to get within closer range.

Zorilla, without looking at him, rumbled, "Look, Castriota, it's doubtful either of us will get out of this. I just wanted to say, I sized you up wrong on the *Titov*. I thought you were some criminal stute pulling a romp, which included knocking off the real Roger Bock. At any rate, I'm sorry I roughed you up those two times."

It was hardly a time to start a mutual admiration society, but Enger growled. "I got the wrong idea about you, too, Curro. Sorry."

As they ran, Enger noted that still more colonists were pouring out of Tent City now. Those who didn't have firearms were forming a line not fifty feet before the first tents. They bore farm implements, axes, pieces of pipe, clubs and other improvised weapons. Their line

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wouldn't have held five minutes before the numbers and weapons of the Kogs, but they were there.

Forward, too, were running a dozen figures bearing stretchers and supervised by the nurses of the Tent City hospital. Frank Kelly had evidently set up a field hospital near the edge of town and was working on some of the wounded there, while dispatching more serious cases back to the hospital proper, where, evidently, Doctors James and Miltiades were holding sway.

In the distance, Enger could see Captain Gluck and members of the *Titov's* steward department, coming up. Gluck, at least, bore a rifle.

Steadying his weapon with both hands again, he emptied it into the onrushing ranks of the Kogs, jumped to his feet once more and ran for the rear, even as he banged a new clip, his last, into the blaster.

As he ran, he nearly stumbled over the fallen body of little Lefty, bartender at the First Chance. There were three bolts in his back in a neat pattern. Beside him was a revolver of the type long ago called a bureau drawer special—an inefficient, inaccurate, small calibered weapon meant for home use.

There was no time for such thoughts but it came to Enger Castriota that there must have been a good many more firearms in Tent City than Captain Gluck had ever dreamed. Probably the majority of the passengers of the *Titov* had smuggled aboard such a weapon as Lefty had carried. A bullet-propelling gun never expected to be used in serious combat, but the type of weapon to be found in a hundred thousand collections the Earth over.

But though hundreds of colonists might romantically have come to their new world, so armed, Enger Castriota doubted that many of them had thought to bring an adequate supply of the shells the guns depended upon. Probably the majority had no more than the gun would hold in one loading, six shots, or at most ten if it were an automatic.

They were less than a quarter of a mile from Tent City now, and though the advance of the Kogs had slowed down under the high rate of casualties they had taken from the firearms of the humans, still more of their hundred-groups were streaming from the forest. At the lowest estimate, Enger agonized, there must already be five thousand of them, and more coming.

He attempted to save some of his last rounds, for once his blaster was empty, he was weaponless. He kept his eyes open for a fallen compatriot who had dropped a firearm that might still be loaded, but he was not alone in this. Fully a quarter of his fellow colonists, their ammo expended, were streaming back in the direction of Tent City, anguish on their faces but helpless without usable weapons.

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Zorilla had disappeared somewhere along the line. Perhaps he had been killed, Enger didn't know and had no time to care. The battle was going on along a line possibly half a mile in length, and he had no way of following developments, other than in his immediate sector, and little time for even that.

A score of colonists and crewmen he had known by name he had seen fall. Nor could any, once down, be expected to survive, since the Kogs immediately beheaded any wounded they overran.

Samuelson, the belligerent crewman who had refused to join Ten Eyck's police force, had died a hero. Unequipped with a firearm, he had made his own countercharge into the ranks of the dancing, screaming Kogs, armed with an ax. Little taller than the diminutive enemy, he had beaten his way into their pack and to its center, chopping and hacking in a red rage until finally he had made it to the unarmed, wide-eyed Kog who bore aloft the swastika emblem this group of one hundred centered about. With a yell of rage, he chopped, once, twice, and the bearer went down, bearing his symbol with him.

A screaming which tapered off into a groan emanated from the throats of the rest and they leaped to the attack, ignoring now the ax from which a moment ago they had flinched. Samuelson was borne down in the rush, never to rise again. However, he had accomplished more than he might have with a blaster, for the group had evidently been demoralized. Whether through the single-man attack or the fall of their swastika couldn't be known, but they dropped behind in the fray.

It came to Enger Castriota, even as he ran in one of his periodic retreats, that he still carried in his jerkin pocket the charges he had taken from Barney's weapon the other night when he had disarmed the man. The only clip he had left was in the gun. He spun, emptied the weapon into the nearest mob of Kogs, and turned again and ran, fishing the charges from his pocket, dumping the clip from the blaster and reloading it.

He couldn't do it while running, without risking dropping some of the precious charges. He came to a halt and deliberately fed them, one by one, into the clip.

Looking up, he realized that he was almost to the outskirts of Tent City. Frank Kelly's improvised field hospital was being picked up and taken to the rear. The Kogs would overrun it in minutes.

He looked back over the way they had come. At least a hundred colonists wallowed on the ground, or were still. The fire of those remaining had fallen off in volume considerably, partially due, without doubt, to the casualties taken but also to the fact that ammo was becoming scarce. Few there were who

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could be in much better supply than Enger, and he now had but half a dozen shots remaining.

And still the Kogs came on, screaming their hate, in their half dance, half run. At least, no more seemed to be emerging from the trees from which they had first erupted, but no more were needed.

Enger Castriota darted his eyes left and right. The colonist line was crumbling. In minutes, the enemy would be among the tents. He had no way of knowing whether or not the noncombatants there had fled out the other side of the improvised town. That is, such noncombatants as there might be. From all Enger could see, the whole community had come forth to offer defense, save only children not yet in their teens.

Above the roar of the conflict he could now hear Ben Ten Eyck's rasping voice. "Fall back on the ship! Fall back on the *Titov!* Security police and those with guns hold the line. Everyone else fall back! Abandon the settlement!"

Ai! Fall back on the *Titov*. There was no place else to go. But what did the *Titov* offer? There would be insufficient food and water aboard for more than a day or two, and insufficient fuel to burn off. Insufficient medical supplies for the wounded, since the medical supplies and equipment would largely be left in the abandoned community, with almost every other need the colony had.

In surprise, Enger noted the captain next to him, glaring, as always, his indignation. But at least, now, not at a fellow Earthling. At his feet sprawled Chief Steward Peter Zogbaum, a blowgun dart in his throat, two bolts in his chest. He had borne nothing more than a meat cleaver in way of a weapon.

The captain, evidently with no intention of retreating farther, no matter what Ten Eyck's shouted orders, was firing calmly into the ranks of the prancing, charging natives, each shot of the old-fashioned, telescopic sighted high velocity sporting rifle bringing down at least two of the creatures.

Enger Castriota snapped suddenly, "Are you particularly good with that gun?"

The captain paused not at all in his shooting. He growled, "I don't have to be, with them packed solid like that."

Enger licked combat-dry lips. "Give it to me!" he snapped.

The captain was surprised enough to stop shooting and stare. "Have you gone drivel-happy?"

He didn't have time to argue. Enger brought up his blaster and leveled it at the other's belly. "Give it to me, or I'll take it. You can have this one."

The captain's gray eyes bugged. He looked down at the heavy hand blaster which threatened him. His eyes darted around for assistance against this madman, but there was no assistance.

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Enger reached out and grabbed the rifle suddenly, so suddenly that the other couldn't retain it. He tossed the blaster to Gluck and whirled, throwing the rifle's bolt and applying his right eye to the telescope.

The captain stood blankly, Barney's blaster in his hand. For the moment, he looked as though he were going to use it on his seemingly mad fellow Earthman.

Enger sought desperately and finally located his target. Possibly two hundred yards to the right, the group of natives surrounding the platform which held the phallic symbol, were pressing toward Tent City, now within easy crossbow range.

The crosshairs found their objective. He gently squeezed the trigger, shifted quickly and squeezed again.

The platform, unsupported on two sides, toppled slowly and the six-foot high symbol it carried crashed to the ground.

XI

The meeting which was held later in the lounge of officers' country on the *Titov* was attended not only by Company board members including the ship's officers, but by the full committee of the Tent City colonists as well. For some reason unknown to him, Enger Castriota had been invited to sit in, possibly, he thought due to his office as town police officer.

The lounge was never meant for this number of persons, and some had to stand. There were chairs for the captain and his men and for the board members, though Cathy, as usual these days, preferred to take her position with the colonists.

The captain, ignoring Pater William for once, had opened the meeting with uncharacteristic unction and a suggestion that a vote of thanks be given Citizen Enger Castriota for his action which caused the collapse of the Kog attack. The applause was sustained. Even Leslie Darleen, his face for once free of cynicism, joined in, the matter of the slapped face evidently forgotten. The look on Cathy's face would have been enough, however, so far as a flushing Enger was concerned.

The skipper looked at him quizzically. "I still haven't figured it out. How did you know what to do?"

Enger shrugged. He suspected that before this meeting was over fur was going to fly, and the present atmosphere be one with the snows of yesteryear.

He said, "It became obvious that they were fighting in clans, each clan carrying its . . . I suppose totem is as good a word as any. But they were also united, fighting under the superior totem of the whole tribe, that object being carried on the platform. It was obviously their holiest of holies. When Samuelson rushed one of the groups with his ax and brought down its swastika emblem that clan was de-

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moralized and dropped out of the fight. I should have realized then, but wasn't thinking in the heat of the fight. Later, when I saw the captain, here, with his telescopic sighted rifle, it suddenly came to me. I"—Enger cleared his throat—"exchanged guns with him and brought their supreme totem crashing down, by shooting two of its bearers. It proved even more effective than I had hoped."

A deep, sighing breath went through the group.

Ben Ten Eyck, a bandage covering one side of his face, said worriedly, "It doesn't mean they won't be back and half the weapons we've got are out of ammo."

Curro Zorilla rumbled, "We can issue more from the ship's stores." He had an arm in a bloody sling.

Ten Eyck was shaking his head. "That's not what I meant. Half the guns are of old, odd models, and of odd calibers. Most of the hand weapons and even sporting arms in Tent City were antiques brought by individual colonists. We still have ammo for my men who carry standard blasters, but there's hardly a round left for those off-beat deals."

The captain rapped, strangely optimistic in view of what had just been revealed, "This brings us to the crux. As you know, we captured three of the Kogs, two wounded, but one who had merely been stunned."

"I say slit their throats," Ted Shackleton of the colonist committee growled.

"My son," Pater William said chidingly. "They are the Great Power's children, even as you and I. And, I must say, even humanoid in appearance."

"Humanoid is correct," the captain said. "So much so, that Dr. Francis Kelly informs me that it is his belief that the Kogs would be susceptible to various Earth diseases."

A silence fell.

The captain said, "There is another element that fits into the situation. Perhaps you have noticed that since the first discovery of the Kogs by Richard Fodor, our two larger floaters have spent practically all of their time out scouting."

Enger had noticed that. The larger and faster one, in particular, had been gone for days at a time.

Captain Gluck had gained the undivided attention he was obviously working for. He said now, "Their discovery is that the Kogs have evidently evolved only on this continent—or, rather, island, since it is hardly large enough to deserve the former name."

There was immediately an unbelieving buzz of excitement from all except the ship's officers who were evidently privy to the captain's information.

"Impossible!" Leslie Darleen ejaculated. Of all present, he alone had evidently missed the day's action, or so at least his state of foppish dress would indicate.

The captain turned on him. "But

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true. The scouting has been most thorough. None of the other continents or major islands of New Arizona support Kogs."

"It's not as unbelievable as all that," Hugo Miltiades put in thoughtfully. "Evolution can go along one path here, along another there. Remember such animals as the kangaroo, on Australia? It evolved nowhere else. Australia had been cut off from other bodies of land so long that evolution took its own paths there."

The captain nodded. "Possibly there has been less shifting of the continents on New Arizona than on our own world, and this island has been cut off from contact with the rest of the planet long enough for the Kogs to have evolved from lower life forms. And they haven't got far enough to build boats capable of taking them to the next land body."

"Which is one way of explaining it," Enger said under his breath. Cathy, who was standing next to him, frowned her puzzlement, but he said nothing further.

The captain slapped his hand lightly on the table, as though signifying that enough had been said on those aspects. His bleak eye went around the group.

"We now come to the point. Dr. Kelly believes that, with a very small amount of laboratory work, he would be able to inoculate our three prisoners with such Earth type diseases as measles and small pox."

Leslie Darleen murmured, "History repeats itself. The explorers, missionaries and pioneers bringing the blessings of civilization to the natives."

Ten Eyck rasped nastily, "The parallel isn't exactly correct, Citizen. It's life and death. It's either all of us, or all of them."

Enger looked at him thoughtfully, but held his peace.

The captain, irritated by the interruptions, went on. "There has been some mention of the fact that the Kogs were intelligent, though my interpretation is that they hardly can claim this classification, being little, if any, more advanced than anthropoid apes back on Earth."

Leslie Darleen's eyebrows went up and Enger Castriota's face went flat.

"However," Gluck said sourly, "perhaps an enemy of the Company might make an issue of this back on Earth and even gain a hearing, especially among those powerful elements who would prefer New Arizona became an Earth colony, rather than continue as the private possession of the Company."

Dr. Miltiades said, "If the Kogs are intelligent, Captain, then the New Arizona Company folds up."

The captain nodded. "Yes, and possibly all of us will be shipped back to Earth while Earth authorities open communication with the

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Kogs; these subhuman animals who, without provocation, have attacked and butchered at least a couple of hundred of our bravest colonists."

"So you suggest—?"

"Compromise between Company and colonists which none, except we here, will know about, and for which we will all be equally responsible. If Dr. Kelly will prepare his germ warfare weapons, the board will tear up the second contracts signed by each colonist. This will allow each to share in the Company profits since they own one share in New Arizona through Citizen Bergman. We have begun repairs on one of the lifecraft. When they are completed we will send it to the nearest Space Forces base where contact will be re-established with Earth and some basic concessions sold. By that time, there will be no Kogs left, since they will have been somewhat mysteriously wiped out by disease. The question of their intelligence will never arise, since it will be beside the point."

Cathy said, "Actually, all you're promising us is what is already ours, one seat on the board and its profits."

The captain's eyes was flinty. "I am also showing you a manner in which our lives will be saved and we will not have to leave this planet penniless."

Pater William said thoughtfully, "After all, they are nothing more than animals."

Zorilla rumbled, "If word got out that we had deliberately spread disease amongst the Kogs, our names would be mud."

Ben Ten Eyck broke in, raising his voice momentarily, but then letting it sink back to normal. "The word wouldn't get out. Nobody but we here would know about it." He seemed quickly to come to anger. "What are we arguing about? It's our lives against theirs!"

"And besides," Enger Castriota put in coldly, "there's a sizable profit involved. That is, *if* we finish them all off. And no profit at all, if we don't."

Jeff Ferguson said gruffly, "What's the alternative, Sheriff?"

"There is no alternative! We've got to wipe them out," Ten Eyck all but shouted.

Enger looked at him curiously. "I can think of two alternatives to this germ warfare, right off the bat. We can retreat back into the ship, reloading our supplies, until Jeff here, and the other engineers and mechanics can turn out some more effective weapons. We have the know-how; in a week or so we'd be able to defend ourselves adequately and emerge again. But there's a better alternative. The captain says there are no Kogs over on the mainland. Fine, we can move ourselves over with our floaters."

Ferguson grumbled, "We couldn't move our heavier equipment by nardy floater, laddy. They're not large enough."

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Zorilla said thoughtfully, "Perhaps we could build barges and boats large enough to transport everything across."

"That would take too long," the captain rasped. "There's only one answer, finish these animals off, once and for all. Then New Arizona's ours!"

Enger Castriota came to his feet and swept the whole group with one glance.

"The captain continues to miss one vital point. And that is that animals don't mine metals and they don't work bronze and manufacture crossbows. Nor do they have a spoken language—nor a religion."

He had left before the others. His words had brought forth such a storm of argument that he could see little reason to participate until tempers had died down and everyone involved had had time to think things over. Not that he could see an end to argument, anyway.

Even Cathy had seemed confused. But why did he think in terms of *even* Cathy? The captain's scheme gave her an answer to problems she hadn't earlier been able to solve. Her colonists would become enriched, even with but one share of the New Arizona company to split among themselves.

He had walked from the *Titov* back to Tent City and the combination living quarters and jail he shared with the Brunner brothers. He had entered, half expecting to greet his two assistants before remembering that Jimmy had gone down under the machetes of the Kogs and that Ed was in the overflowing hospital with an amputated leg. The darts of the Kog blowguns were highly poisoned.

For at least an hour, he stretched out on the army cot which was his bed and stared up at the tent's ceiling. Matters were coming fast to a head. Ten Eyck had been right. The Kogs would come again. There was something in them that was propelling them into action beyond ordinary reason.

But, of course, they might not attack immediately. They had taken heavy losses, been sent reeling back, their supreme totem destroyed.

How long did it take smallpox—or measles—to go through a race of people who hadn't been exposed to it? He knew little about the subject, but he seemed to recall that it could be a very short time. There were other contagious diseases too, cholera, plague. But possibly Doc Kelly was in no position to develop a strain of these.

He wondered, vaguely, now that he was here, why he hadn't brought up his main point of argument against Gluck and those who supported him. He shrugged. He had no proof.

There was a cough at the tent entry.

Enger swung his feet around and came erect. "Come in."

It was Pater William, anxious of

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moon face. He patted his tummy through his brown monk's robes. "I am sent as a messenger, my son."

"Oh?" Enger looked at him. "Well, sit down, Pater William. A messenger from whom?"

The Temple monk looked about this room of the tent, spotting nothing in the way of seating arrangement save the bed and two folding chairs. He sighed and chose the bed. Enger seated himself across from the other.

The Temple monk pursed his lips and said, "The first of two messengers, perhaps I should say. If I fail in my mission, I understand that Ben Ten Eyck and a squad of his men will come next."

Enger chuckled sourly. "Threats don't go with your calling, do they Pater William?"

The other cleared his throat, looked chidingly at his host. "My son, Captain Gluck has been reconsidering a hasty decision he made the other day. He has come to the belief that he acted precipitately. Now, particularly after your gallant action of this afternoon, he wishes to make amends."

Enger looked at him blankly.

Pater William nodded. "He realizes now that you are, in truth, Roger Bock, a member of the board of the Company and consequently a one-tenth owner."

Enger Castriota gaped.

The Temple monk patted his tummy, with both hands this time, but said nothing for the moment.

Finally Enger managed, "This is fascinating. But suppose I do return to my former quarters on the *Titov* and resume my . . . uh, duties as a board member. What happens, eventually, if someone else claiming to be Roger Bock turns up and wants the seat?"

Pater William nodded and continued the pretense. "The captain wishes to make it clear to you that whatever steps might be taken in the future to attack your rightful position on the board, it is guaranteed that you will have a seat. In fact"—the Temple monk beamed here—"it was put to a vote and the majority of the board so voted."

Enger Castriota said, without warmth, "You mean the board has voted me a full seat in the Company whether or not I am really Roger Bock?"

"Well, that would be one way of putting it."

"By unanimous vote?"

"Well, not exactly. First Engineer Jefferson Ferguson and Citizen Zorilla seemed disinclined. The rest of us, of course, overruled them."

"I see," Enger said.

They remained silent for a time while he thought about it. This development was completely unexpected.

He looked up and said, "You mentioned being the first of two messengers. What . . . uh, message will Ben Ten Eyck be carrying?"

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"If my mission fails, he is to take you into custody and return with you to the *Titov* so that you will be unable to spread malicious rumors through the colony."

"I see. And even . . . Citizeness Bergman and the colonist committee agreed to all this?"

"I do not known how Catherine herself voted, my son. The committee withdrew to a separate room, came to agreement within itself and when it returned, Catherine so voted."

Enger Castriota grunted bitterly and came to his feet. "How soon does he turn up? Ben, I mean."

"Why, he and his men are but a few yards down the street, ah . . . Roger, my son." His voice as always was kindly. "He will conduct us back to the *Titov* whatever your decision."

So, they had no intention of having him blabbering around.

Enger said, "I see. Pater, I'm going to have to leave. You stay here for the time."

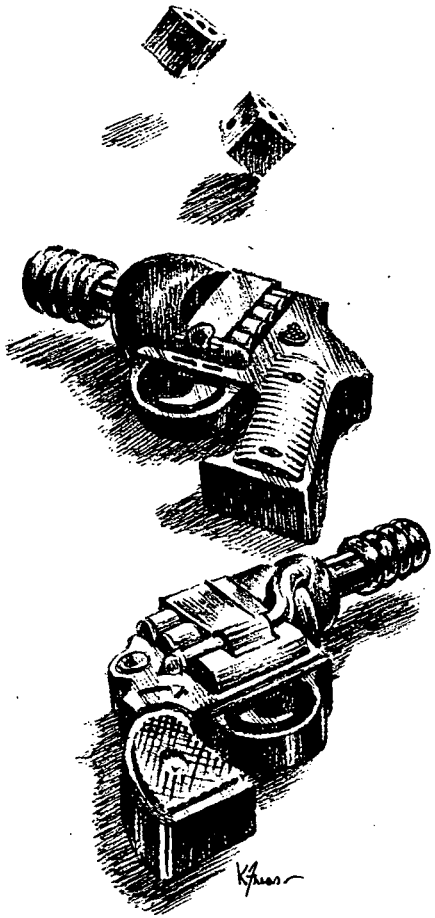
The Temple monk frowned worriedly. "But, my son, Ben Ten Eyck and his men are right outside. If they see you emerge, it will be assumed that you are going to . . . well—"

"Spread malicious rumors?"

"Well . . . perhaps—"

"Fine. Then what I'll do is go under the back flap here, and he won't see me, will he?" Enger Castriota picked up his baton.

"But, my son, ah, Roger. I—"



It was at that moment that something clicked in the mind of Enger Castriota. He said, very slowly, "It occurs to me, Pater William that that is the only name by which I've ever called you. What is your last name?"

"Well, as you know . . . Roger, the Temple monk gives up his patronymic name at the same time he swears the celibate's oath."

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"But it was—"

"Peshkopi. A very old Albanian name, so I understand."

Enger Castriota looked at the other for a long moment.

He said finally, wearily, "My own last name is Albanian. You have never heard it before?"

"Bock?"

"Castriota."

The Temple monk shook his head, his plump jowls quivering. "No, I don't believe so. I have never been to the old country."

Enger stared at him for a moment longer, then shook his own head as though impatiently. He reached down under the cot and brought forth one of Rog Bock's bags. Squatting on the floor, he opened it, shuffled through it for what he wanted.

He came erect again, said curtly, "I'll see you," and headed for the rear flap of the tent.

His goal was a more than averagely large tent located not far from the Administration Building. There was a light burning, which was a relief.

He pushed through the entry without notice and found Jeff Ferguson working over a tool-strewn bench.

Enger said, "I thought you'd be back on the *Titov*. Still arguing."

Jeff Ferguson hardly looked up. "Lot of jetsam and curd being thrown back and forth there," he groused. He was soldering something.

Enger nodded at the gadget the other was working on. "What're you making, some sort of death ray to do in the Kogs?"

Ferguson grumbled sourly, "Something like that. I haven't got a blaster."

"Is it going to work?"

"No," the other grunted. "What do you think I am, a mad scientist?"

Enger said, "Listen. I'm rapidly coming to the conclusion that you're probably one of the only two or three people that feel the same way I do about this colony. Do you want to do something about it?"

"Do what?" the other grumbled suspiciously.

Enger told him. It took a full ten minutes, including the other's arguments that had to be rebutted.

Jeff made an ugly face. "We couldn't pull it off. I haven't even got a gun."

"I'll take care of that. Can you get the miniature transmitter?"

"Already got it. Zorilla wanted a few the other day. He had the idea of trapping a couple nardy animals, putting a bug on each of them and then being able to trace down where they go, where they water, by training them with a direction finder. Me and Sparks did them up."

"All right. Where are they keeping the Kogs?"

"In the Administration Building."

"Meet me there in half an hour, Jeff."

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Enger Castriota left the engineer's tent and made his way with care to the larger of the gambling tents. He assumed that Ten Eyck was already looking for him, and didn't want to be bothered with pursuit at this stage.

This was crucial now. If the town had given up gambling and drinking tonight, following the all-out combat which had taken place in the afternoon, he was stymied.

But they hadn't. In fact, there seemed an added stimulation in the air, a heady something that affected all, as he pushed his way into the improvised gambling hall. He went directly to the craps table.

The croupier, a bandage on his head, looked up. "Hi, Sheriff, mighty fancy shooting there this afternoon." In general, his appearance was well received, most didn't know quite what he had done, but somehow the sheriff had saved the day.

He picked up the dice. "This is my lucky night," he announced. He tossed the blaster he had fought with against the Kogs to the table. "I don't want to exchange this for chips. I want somebody to fade me with another gun."

The croupier scowled. There would be no percentage for the house in that. He shrugged. The sheriff was the sheriff, and tonight the hero of Tent City.

Somebody said lowly, "That's Barney's blaster."

Enger Castriota turned an icy eye on the speaker. It was one of the two outbackers who had helped the wounded Barney back to safety. Enger said with a killer's cold, "It's my blaster and I'll smash the man who says otherwise."

Somebody else said, "I don't care whose it is. It's worth its weight in gold ten times. Here." He unstrapped his own holstered sidearm and tossed it to the table.

All eyes went to the two weapons, most of them agleam. There were few weapons remaining in Tent City complete with ammo to fit them as Ben Ten Eyck had pointed out earlier.

While attention was diverted, Enger Castriota had switched the house dice for those he had brought from Roger Bock's suitcase. He had noted idly several days earlier that they were similar in color and of gambling house standard.

He shook them briefly, bounced them against the table side.

Seven.

He said, "Both handguns against a rifle."

"I'll take that." A blaster rifle was shoved onto the table.

This time he flicked his hand slightly, in the manner he had practiced on the *Titov* when he had first found the dice, seemingly so long ago. It came up a nine. He continued to roll in the manner which he knew made it impossible to crap out. Another nine eventually showed up.

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"Let the rifle ride," he snapped, picking up the two hand weapons.

Eventually the bet was covered. He rolled.

Seven.

He belted on the two hand weapons, picked up the two rifles.

The croupier said coldly, "Let me see those dice . . . Sheriff."

The handgun he had won was an old-fashioned revolver. Enger Castriota, looking into the stickman's eyes, flicked the chamber out as though to check to see if the gun was loaded. It was, as all were aware. His eyes were infinitely icy, black death behind them.

"I don't like your implication, you cloddy."

The houseman's eyes flicked right and left. There were two muscular house guards supposedly at call. They made no movement.

Enger grunted and dropped the dice into his pocket. He turned and without another word, left the tent, not hurrying.

Once outside he increased his pace, and there were blisters of cold sweat on his forehead. He had to move fast now. The croupier would be talking. In his business, he had undoubtedly seen similar dice more than once. Probably only the shock of seeing them manipulated in the popular hand of Enger Castriota had kept him from speaking up earlier.

He cut through some back ways, on the off chance that already there might be pursuit, or that Ten Eyck was searching the town for him. He made it to the side of the jittering Jeff Ferguson almost exactly on the half hour he had specified.

The engineer demanded anxiously. "Where've you been?" And then, "Zen! Where'd you pick up that nardy arsenal?"

"I'll tell you later. You've got the mini-transmitter?"

"Sure. I said I'd have it, didn't I?"

Always belligerent. Well, they were probably going to need some belligerence. "Come on," Enger said. "Let's get the Kog."

That part of it was easy. They simply entered the Administration Building, armed as they were to the teeth, and Enger said to one of the four guards, placed over the three little brown men. "We're to take the one that isn't wounded."

The guard shrugged. "Sure, Sheriff. But keep your eye on him. These little monkeys are tricky and that's no jetsam."

Up close to the brown man who was ushered forth, it was ever more obvious to Enger Castriota that to brand the other an animal was ludicrous. In fact, there was a definite handsomeness to the Kog.

The Kog's hands were tied behind him with rope. The guards checked the knots, while Enger and Jeff agonized. However, they couldn't show impatience without possibly causing suspicion. What

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was there to be in a hurry about?

They left the Administration Building and headed directly for the landing field.

"You're sure," Enger said, "you can pilot the four-seater?"

"I can pilot 'em all, laddy," Jeff said indignantly. "They're fool proof. Anybody can pilot a nardy floater."

"All right, all right," Enger said. "Let's hurry. If Ben Ten Eyck spots us, we're in the soup."

Which was exactly when the shout came from behind them.

"Hurry him along!" Enger snapped. "I'll cover. Get to the floater."

Jeff disappeared into the dark, pushing the little brown man ahead

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of him and swearing bitterly as he went.

Enger pulled his blaster, aimed it in the direction of the shout, but slightly up into the air, and fired three quick blasts. He leaped as far to his right as he could, and then shuffled three or four more quick sidesteps.

And only in time. A volley of fire from at least four weapons answered him, blasting the area from which his flash had come only split seconds before.

He turned and ran in the direction in which Jeff had disappeared with their prisoner. Fifty feet farther on, he turned and, slipping the rifle from its sling over his shoulder, let loose four or five shots as quick as he could pull the trigger. He dropped to the ground and rolled desperately, avoiding the return fire.

They were still coming, but not so anxiously.

He came to his feet again and dashed at top speed for the landing field. At least, his pursuers would have no idea as to his destination. Not quite yet, at least.

They must have caught on quickly, though, when the roar of the engines warming up blasted the night air. There was a shouting and a pounding of feet.

Enger Castriota grinned wolfishly, and sprinted for the floater.

Jeff had the door open for him. He scrambled in, but didn't close it. Instead, he leaned out and fired his handgun until it was empty, still slightly up into the air, but the foe wouldn't know that.

The craft jumped forward, upward, hesitated a moment, as a horse hesitates and rears to its back feet before taking off in a mad gallop. Then it shot forward into the night, disappearing from the sight of those who followed shaking fists and guns meaninglessly.

"Ten Eyck," Enger growled. "He's already on the trail and willing to shoot."

"Wouldn't blame him," Ferguson grumbled. "How's our nardy prisoner?"

Enger Castriota was sitting in one of the two front seats, beside his companion. The Kog was in the rear. He turned to check the little brown man, and just in time. The other was coming toward them, his wiry hands like claws.

"Zen!" he complained, as he slugged the other with the side of his right hand. "That guard was right. They're tricky."

"Where do you want to put him down?"

"I'd say head over in the direction of the clearing where the Kogs first jumped Fodor. Halfway there, we'll drop him some place. We have no guarantee, but it should be nearer than if we ditched him here and time's going to be precious. I was hoping we'd have time to sabotage the other machines."

Jeff grunted gruffly. "We hardly

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had time to burn off in this one. We're lucky we aren't all three crisp."

"You had time to plant that mini-transmitter on him?"

"No."

"Better do it now, while he's out."

"Take the sticks, laddy."

"I don't know how to fly these things."

"It flies itself, don't be a nardy funker."

Enger Castriota sighed and took the floater's controls gingerly.

In about half an hour they located a clearing below them and dropped to it.

Enger hopped out and motioned to the Kog, whose hands were tied again. The little brown fellow had obviously been frightened by their noisy progress through the air, but not terrified. He climbed clumsily from the floater and stared defiantly at the white man who hulked above him.

Enger wished there was some way to communicate but there obviously wasn't. Some gesture of friendship might have paid dividends later. He shook his head, turned the Kog around and undid his bonds.

He gestured toward the trees.

The other stared at him in surprise. He had evidently expected to be killed. He turned quickly and trotted away, disappearing without looking back. His route had been north and east.

"What do we do now?" Jeff grumbled.

"Nothing, I guess. Not for a while. At night in these woods I doubt if he makes three miles an hour. Can you pick him up on your zeroer?"

"Nardy well right. I put two bugs on him, just in case."

A dark shape swooshed over them, not fifty feet above, and fire blasted from its belly.

"Let's get out of here!" Ferguson yelped. "It's that curd, Ten Eyck."

XII

Their attacker had overshot the small clearing in which Enger and Jeff had set down to release the prisoner. Overshot it, but from the drumming sound it was coming around again for a second pass.

Their engines had never been turned off. The engineer slapped controls and they bounded skyward again. Enger fumbled around the control board, turning off even the dimmer lights.

"That one's faster than we are," Jeff complained gruffly.

"But in the night . . . ?" Enger demanded.

He could see the other scowling puzzlement, even as he worked continually, reaching for altitude, dodging the efforts of the other floater to get into position to fire on them again.

"Zen, yes! How could they have nardy well found us at all?"

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"It wasn't minutes after we landed before they came sliding up!"

Jeff Ferguson ran a disgusted hand over his mouth. "What a nardy cloddy I am! I installed the nardy thing myself. Here, take the controls."

"I told you I can't fly—"

"Shut up, laddy, it's all yours."

The engineer sank down onto the floor and fiddled beneath the control board.

"What kind of jetsam goes on here?" Enger demanded. "Take these controls! That other pilot can fly circles around me."

"Here it is," Jeff grumbled in disgust, ignoring him. He came forth with a small gismo which trailed a couple of wires. He tossed it out his window and it fell to the forest beneath. Almost immediately, Enger spotted the dark shape of the other craft go whooshing down in a fast dive.

Jeff grunted. "While we were getting ready to follow our Kog with a zeroer, Ten Eyck and his boys were already following us with one. Each of these hovercraft had a mini-transmitter in it so if there was a crack-up the other could find it."

Enger shook his head in relief. "We ought to be able to duck them in the dark then, eh? As soon as you've done that, let's set down again and get a fix on our friend."

Jeff grunted. "You know, there's one possible hole in your basic idea, laddy."

"How do you mean?"

Jeff Ferguson flew quietly, without looking at the man next to him. "The boys who scouted out the nardy island this past week in these floaters spotted Kogs dozens of times. But they were all in small groups. Sometimes nardy hunting parties, sometimes fishermen out in kind of dugout canoes, sometimes little settlements of houses up on nardy stilts and made out of a kind of bamboo. But there wasn't any town."

Enger wet dry lips. "That fits in with the way they fought. They live in clans, a few hundred of them together, at most, including women and children."

"Yeah. What I mean is, there isn't going to be any main city our boy is heading for." Jeff began peering below to make out a clearing suitable for landing. "He'll just be heading on home. So what good will that do us, laddy? He'll lead us to some nardy bamboo hut."

"That's the gamble," Enger admitted worriedly. "But I saw something in the fight yesterday that nobody else seemed to notice. I think they've got a central, well, headquarters, temple, shrine, call it what you will. And I'm hoping our Kog will head for it to report."

Jeff grunted skepticism, and his eye took in the zeroer-finder needle. "He's heading that way. I'll set down somewhere and maybe we can take a nardy nap while he gets some mileage performed. We've shook old Ten Eyck."

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The chase continued through the night. Periodically, they would lift, advance a few miles, set down again. They didn't want to get too close to him, for fear he would realize they were following and, not wishing to lead them to his destination, take off in another direction.

He made better time than Enger Castriota had expected. Evidently, running along forest trails at night had no fears and few obstacles to a Kog.

Once, at a distance, they made out Ben Ten Eyck's floater obviously still searching for them, although the micro-transmitter they had carried before was no longer aboard. They settled into a tiny clearing, to hide. Ten Eyck's chances of locating them again were infinitesimal.

With dawn they dropped farther behind their quarry, and remained closer to the tree tops, not only to remain hidden from the fleeing Kog, but to lower, still further, the chances that Ten Eyck might in a one chance in a thousand piece of luck spot them. If he did, in daylight, they'd have their work cut out escaping.

It was toward noon that Jeff brought Enger out of his doze by grumbling, "He's stopped."

"What?" Enger shook his head for clarity and stared blearily at the zeroer's needle.

"He's stopped. Probably taken time off for a sleep. Zen! he must nardy well need it by now."

Enger, fully awake, was shaking his head again, in negation now. "No, if he were going to sleep, he would have done it during the night. He figured he was close enough to wherever he's been heading to make it without rest. Slow down, Jeff but keep coming up on him."

"You're not afraid he'll spot us?"

"I don't care now. But you'd better take more altitude. A crossbow bolt could reach us at this height."

Jeff peered down at the forest beneath them, shaking his head discouragedly. "There's nothing down there. And we're almost up to him, wherever . . . Hey!"

Enger Castriota's eyes were as wide as those of the engineer.

"That's it," he breathed.

Jeff finally tore his eyes away from the ruin below them and looked at his companion as though accusingly. "You nardy well knew it was going to be there."

Enger grunted. "Remember the platform those four Kogs were carrying, with their holiest of holies on top?"

"The phallic symbol?"

"That's it. Nobody looked at it as carefully as they might have. I suppose there was too much excitement. And then, later, the Kogs made off with the remains. But anyway, it wasn't a phallic symbol. It was the replica of a spaceship. And down there's the original."

Jeff goggled, letting comprehen-

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sion flood over him. "It's all but swallowed up in that nardy jungle. But . . . Zen, that means—"

Enger's mouth twisted. "It means the Kogs aren't humanoids—they're humans. Jeff, get down lower. It doesn't look as though there's a settlement around. It must be some sort of . . . well, shrine."

Jeff grumbled, "I could land right on top, beside that port. It looks open. As though it was sprung open when they crashed."

"Take it very easy."

Enger pulled his blaster and examined it. But Barney's weapon was now empty. He grunted, realizing that he should have gambled or traded, there at the games tent, for some extra ammo for the arsenal he and Sparks bore. He tossed the blaster to the back.

The other weapons he went over thoroughly, Jeff's as well as his own. They had no way of knowing what was below.

Jeff said, "There're rope ladders down over the nardy side. They must use that port for an entry. They climb up the ladders from the jungle down below and go in there."

"There's no point putting it off," Enger said. "We've got to go back with some definite proof. Unless they've stripped the interior, and I doubt that, we should be able to find a ship's log, or something."

They settled gently to the fallen spaceship, stretched out on its side for thousands of feet.

"It's an old Kondor," Jeff grumbled. "They've been out of commission for a long time."

"This one's been here for a long time," Enger muttered. "Cover me, Jeff. I'm going on over to that port."

"Cover yourself," Jeff told him sourly. "I'm coming, too. I wouldn't miss this for a bevy of breweries. Give me those guns back."

They left the protection of the floater and started for the entry to the battered wreckage of the old spaceship.

Then, as they stared, four robed brown men filed from the portal, as though conducting a ceremony, chanting something meaningless to the newcomers. Their robes were bright orange and their heads had been shaven clean.

The four, still chanting, and from time to time bobbing their heads in unison, formed a straight line. Then, as though nothing was more obvious, brought from beneath their robes four heavy blasters and pointed them.

"Hey!" Jeff yelled, and started for his own holstered weapon.

"Hold it!" Enger grated, grasping the chunky engineer's arm. "We're covered. They'd blow us to smithereens. Try to look friendly."

"Look friendly!" Jeff groaned.

The chant had ended. Slowly, as though still ceremonially, the four brought up their blasters and aimed them with care, their fingers tightening.

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This then, was it, Enger agonized. He should have let his companion make his play. At least there might have been some small chance.

The four orange-robed figures, their eyes solemn, chanted in unison, "Bang, bang, bang!" Then lowered the weapons again and stared. Stared in disbelief at the two white men, as though having fully expected them to disappear.

Enger Castriota closed his eyes in quick relief.

"Holy nardy Zen?" Jeff blurted. "They're empty."

"And by the looks of them, they-'ve been empty a century or so," Enger said.

Another figure, considerably older than the first four, had emerged from the port, blinking in the light of the noonday sun. He was as bald as the others, but had a wisp of white beard at his chin and stooped in his age. Otherwise he was almost identical to the others, save that around his neck hung a replica of a spaceship, beaten from what Enger assumed was gold. Now that he noticed, the four younger ones had similar symbols, though smaller and evidently of bronze.

The old man returned their stare.

Finally he wheezed, "But you speak the holy language."

Enger and Jeff gaped at him.

Enger shook his head and said, "We speak Earth Basic. We're Earthlings."

"But the warriors reported you were white devils, keeping us from the Heavenship which at long last has come, as in prophecy has been promised us."

Enger had enough presence of mind to shake his head negatively. "We are not devils, but fellow Earthlings, come to help you, either to return to Earth, or remain here on New Arizona and enjoy the fruits of our technology, our . . . uh, magic devices which make life easier."

"New Arizona?" the old man said waveringly. And then, nodding in understanding. "Ah, but we have called it New Bali, this world. I do not know why, the reason is lost in the past—with so many things."

The four younger robed men were staring disbelief at all this. One of them said, his voice less sure of the language he used than his elder, "But . . . then . . . the crusade. It has all been a great mistake."

Jeff grumbled bitterly. "A mistake that killed two or three hundred people, laddy. Not counting your own folks."

They were met by an escort a good ten miles from Tent City. An escort consisting of the two one-man floaters. They were followed in, obviously under cover of blasters in the small, speedy craft.

The scouts must have signaled ahead, since by the time they arrived at the landing field, there was

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already a goodly crowd, and more streaming up by the minute, both from the direction of Tent City and from the *Titov*.

Enger wondered briefly what sort of a story the captain and Ten Eyck had spread around. The fact that he and Ferguson had taken off with four precious weapons and one of the colony's floaters, must have made the tale more palatable.

The floater Ten Eyck had used the night before, was already on the field, and even as they swooped in for a landing, Enger Castriota could see the chief officer hustling up from the direction of the *Titov*, still buckling on his holster harness. He had a squad of four of his security men along.

Jeff made a point of setting down where the crowd was thickest. The craft floated in to a halt and they opened its entry panel and emerged, Enger first, Jeff next, the High Priest last of all.

Ten Eyck was barking, "You are both under arrest—" Then his eyes popped at the stooped little man, his wisp of chin whiskers, his golden spaceship symbol, his bright orange robes.

Enger barked back, "Under whose authority are we arrested?" He could recognize the captain, Zorilla, Pater William, Cathy, all coming up hurriedly. Yes, and over there, Leslie Darleen. The whole colony would be present in moments.

"Under the authority of the board of the New Arizona Company!" Ten Eyck rasped, wrenching his eyes from the High Priest and directing them back at Enger. "Put up your hands while we take those weapons."

"There is no New Arizona Company!" Enger said, his voice loud, to carry.

"Nardy well right," Jeff groused. "There isn't even a New Arizona. It seems the name of the nardy place is New Bali."

Enger ignored the enraged Ten Eyck and turned to the captain, at last on the scene. "Sir, may I introduce Gadjah Mada, Head Priest of the Balis—they call themselves Balis, not Kogs."

The captain's mouth was working like a half starved carp's. His eyes went desperately to Ten Eyck and his armed men, back to Enger and back again to Gadjah Mada."

"What does this mean! Seize—"

In his infinite dignity, the little brown man said, "The pleasure is mine, captain. Do you, then, command the Heavenship?"

Captain Gluck led all the others in the community gape.

"I suggest," Enger said dryly, "that we hold another all-colony conference."

Although relations were changing by the minute, largely the gathering assumed the lines it had on former occasions. The captain and members of the board sat at a table facing the colonists as a

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whole. To one side, this time, sat the colonist committee of twelve, and Cathy with them. To the other side stood the former crew and those elements from amongst the colonists that Ben Ten Eyck had formed into his security police.

To the extent possible, all colonists were present. Even those from the outer pillboxes, even the floater pilots who had watched for a surprise attack, the last time. Even such hospital patients as were ambulatory, or whose cots could be moved without distress.

For all practical purposes, all were here.

And all eyes were on Enger Castriota and the little brown man beside him.

It was the first time in his life he had been called upon to give a speech to a large audience, but he knew that immediate confusion on New Arizona—or New Bali, if you will—and possibly further bloodshed, were dependent upon what he now said.

His eyes went to Cathy Bergman and gained strength. And then, as though magnet drawn, to Pater William Peshkopi and found he knew not what.

The captain rapped, "Well, Citizen! Let us hear your nonsense."

Enger looked at him, finally, and spoke as though to him, but loud enough for all to follow.

"Two or three years ago, Matthew Hunt discovered this planet and laid claim to it under Earth colonization laws. To raise capital, he formed the New Arizona Company, but even then had insufficient capital to do the job right."

"We'll make out, as soon as we've sold a few mineral concessions," the captain rapped, holding on to the bitter end.

Enger shook his head. "You already know better. I used the wrong word, back there. Hunt didn't discover New Arizona. It had already been discovered, once again through accident, by the s/s *Goddard* which managed to crack up in landing. Like ourselves, its electronic equipment was so disrupted that it was unable to communicate with the Space Forces or some other body capable of rescue operations."

He held up a hand to quiet the captain's retort, and now he was talking directly to the colonists. "We don't know the complete story, thus far. We don't even know how far back it happened. We'll probably learn when we find time to go through the surviving papers on the s/s *Goddard* which lies about fifty miles northwest of here.

"However, it would seem that the *Goddard* was transporting either colonists or laborers to some planet amongst United Planets which has a high temperature and probably a junglelike flora. Possibly shortness of stature was another advantage for humans on this unknown world. I don't know. At any rate, something went wrong and it became

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necessary to set down here. Possibly the captain of the s/s *Goddard* circled the planet several times to find the most suitable seeming location. If so, he came to the same conclusions as our own officers and attempted to land the *Goddard* on this island. He crashed."

Enger took a deep breath and looked at Gadjah Mada, who was hunkered down on the ground in the squat common to the natives of southern lands for millennia.

"Evidently, things went quickly to pot. I imagine that the officers and crew of the spaceship were largely of other race than Malay, probably most of them were Caucasians which would account for the present legends and traditions about white devils. It is to be assumed that the officers and crew of the *Goddard*, or at least the majority of them, tried to retain for themselves the supplies and equipment the spaceship had carried. We can assume that there was conflict and that the Malay elements eventually won."

The silence was heavy now. No more protests, no more muttering of disbelief. It was all too obvious.

"When the original supplies gave out, when equipment fell apart, the colonists of the *Goddard* went back to nature, and their memories of the world of their origin slowly faded, until eventually they became a religion. It was a religion that taught that one day a Heavenship would come and return them to a . . . a promised land, I suppose you'd call it.

"There had been both men and women aboard the *Goddard* and this planet is a hospitable one. The castaways prospered. They spread out over the island and the *Goddard* wreckage became a shrine only, a center for the priesthood, a monastery for neophytes. And then, of course, the Heavenship finally arrived—the s/s *Titov*. But to the amazement of Gadjah Mada and his people, it brought along a large number of what could only be recognized as the white devils of legend. Debate was held among the headmen and it was decided that nothing remained but to attack and rescue the Heavenship from the desecrators."

Enger Castriota shrugged, suddenly tired of talking. "I suppose that's the meat of the story. You can figure the rest of it out yourselves."

Ten Eyck was possibly quicker than any of the others in grasping the full significance of the words spoken.

His hand on his holstered weapon, he scanned his armed troops quickly, then brought his eyes back to the center table, to the captain and the Company officials. "So our do-gooder, Enger Castriota, admits we were attacked without provocation. That the New Arizona Colony only protected itself, legally and morally. And now its rights include

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continuing such defense, even to the point of completely finishing off its aggressor foe."

Curro Zorilla lumbered to his feet, shaking his massive head.

"It won't wash, Ben. I'm way ahead of you. It won't wash. There's no way to hide the fact that these Balis, as they call themselves, discovered this planet long before Matthew Hunt ever came on the scene. He had no standing, unbeknownst to himself, when he claimed sovereignty. His landings must have been made on other parts of the planet; he didn't know the Balis existed. The New Arizona Company has no standing whatsoever. In fact, like Enger says, it no longer exists. The planet is now an Earth colony, and, undoubtedly, the authorities in Greater Washington will be sending out the usual conglomeration of officials, scientists and technicians in a hundred categories, to take over its proper colonization." He sat down abruptly.

Ten Eyck began heatedly, "But—"

"Shut up, Ben," the captain rapped.

Ted Shackleton, from the ranks of the colonist committee, suddenly chuckled laughter. "Why then, anybody on this planet is just as good as anybody else, and no better. I've got as big a right to whatever I can make here, as anybody. It's *really* a colony. Each man for himself and the devil take the hindmost."

Leslie Darleen spoke up for the first time. A dozen changes in mien had chased themselves across his face, as Enger's talk had progressed. But now he seemed to have regained a certain confidence.

"Really now, old fella," he said mildly. "You're a bit previous, you know." He looked at the captain, Pater William and the ship's officers, including Ten Eyck. "And you chaps shouldn't get your wind up. Let's accept the fact that Matthew Hunt's claim for sovereignty is invalid. However, there is still a New Arizona Company. The only difference is, it no longer owns New Arizona."

Largely, there were scowls directed at him, scowls of puzzlement.

"It does own practically everything presently worth owning on this planet. The *Titov* and its machine shops, supplies and equipment, most of the weapons, even those tents you colonists are presently living in, all belong to the Company. I might add that you are all under contract to the Company, although, admittedly, the second contract signed will hardly stand up under Earth law. However, the first maintains."

He looked triumphantly at the captain and the members of the board. "For all practical purposes, this planet is still ours."

Dr. Hugo Miltiades was now standing, too, his face going red in high anger. "You mean you still

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expect to exploit this new world for the exclusive benefit of your small clique?"

Leslie Darleen looked at him mockingly, without bothering to answer.

The captain pursed his lips. "We'll have to have an executive meeting to discuss new ramifications," he said thoughtfully. "Actually, of course, it will be a long time before any representatives from Earth even arrive. We have no means of communication." He nodded, thoughtful still. "Things should be fairly well sewed up by time they get here."

Ferguson chipped in there. "Not as long as you think, Skipper. I rescued enough equipment from vacuum sealed, emergency parts on the *Goddard* to fix up our radio. Sparks and I'll have it working in a week."

Sparks said shrilly, "And don't anybody think in terms of sabotaging that project, cause I'm going to sleep in the radio shack until the job's done."

The captain glowered at his former first engineer. "You seem to forget, Mr. Ferguson, that you are a part owner in the Company and all its possessions, and your interests lie with ours."

"Yeah, and I'm also a nardy citizen of this nardy planet and I want to nardy well get along with my fellow citizens, laddy. I can make my own way. I don't need the ability to starve people into submission, so they'll do my work for me."

"Easy, easy," Leslie drawled. "Nobody spoke of starving anyone, my dear Jeff. It's simply survival of the fittest, and we who own the ship's machinery, its tools, its library, its weapons, seem to be the most fit. We shall then, ah, profit a bit more from our new home than those without ownership of such items."

Curro Zorilla, ever bull-like, lumbered back to his feet. He looked at Leslie Darleen expressionlessly and said slowly, "When I was in school, I read an account of a British outfit, way back in the early days of Australia, who figured on starting up a new industrial colony there. They figured they'd save on labor costs and get cheaper raw materials. So they equipped a big ship with all the machinery and the supplies needed, and then signed up a whole group of what they thought were yokes and transported the whole to Australia. But they made one mistake. They transported everything except the conditions that applied in England. You see, once in Australia those people didn't *have* to work for the company. There was plenty of land for all. At the first opportunity they just headed back into the boondocks and started up their own farms, or ranches, or whatever. The company's valuable machinery sat there and rusted away."

Ben Ten Eyck rasped, "Whose

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side are you on, Zorilla! You hold a full seat on the board yourself. You have a major interest in this equipment of which we have a monopoly."

Zorilla shrugged huge shoulders. "I'm on the same side as Jeff Ferguson. I don't mind using our equipment. Sure, I'm glad we have it. But I'm not silly enough to try and utilize it in such a way my wife—who is a colonist, gentlemen—is going to leave me because of what I've done to her friends and relatives. Or to be shot in the back some dark night, or have my house burned down by somebody with a grudge."

The captain growled again, "All this should be left for discussion in executive session of the board."

Cathy said sweetly, "Don't forget that I am a member of the board, when such discussion takes place, Captain Gluck."

Enger Castriota, forgotten temporarily, in the heat of the debate, had faded back and worked his way around to where Cathy stood on the edge of the colonist committee.

He whispered to her, "Come on. This can go on forever and little is going to be solved. There'll be a dozen people willing and anxious to give us résumés later on."

She went a few steps with him, until their voices wouldn't carry, and said worriedly, "But I ought to be there."

He took her by the hand and pulled her along, she resisting precious little. He took her to where there was a small mound, a rising above the level of the plain and to where they could look out in all directions: At the looming *Titov;* at Tent City; at the gathering of the colonists below; the recently cultivated fields beyond, and the scene of the battle of the day before; the common graves of its victims.

They stood and watched and his mood grew upon her, too.

Enger said slowly, "You know in actuality most of them, there arguing, are going to make the grade. Even Leslie. He's sharp and he had education, and he has the will to survive. He'll make out fine, on this new world of ours, no matter what sort of socioeconomic system we wind up with. So will the captain, and Ben Ten Eyck—if he doesn't wind up crisp, as a result of some too quick attempt to reach the position he thinks he deserves. And Zorilla, and Jeff, and the rest of the officers. They'll all die happy here on New . . . Bali, surrounded by prosperous fields or industries, and by flocks of children."

"Are you so sure?" she said.

"Um-m-m. Leslie was wrong. Pioneers aren't slobs, or people who can't make the grade. They *are* misfits, and they are malcontents, which only means that they can't bear the petty confinements and the mores of the stilted status quo society they came from. They're mostly highly competent human be-

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ings; those that aren't go under too quickly to even be considered pioneers. A few slobs we have among us, but they're rapidly getting themselves killed in brawls in the bars, or in drinking rotgut jungle juice while they whine about *going home*. All this while the real pioneers are becoming outbackers or are puttering around like Zorilla with his animals, or Ferguson and Sparks with their new ideas on how to adopt to the new environment."

He thought for a moment, then said, "Zorilla must have realized all this early in the game. That the thing wasn't to destroy New Arizona by brutal exploitation, but to develop it and with it all who came to colonize. I suspect it was he who sabotaged the radio and lifecraft."

"It was," she said quietly. "He told me, after that scene where the captain accused me and wanted to strip me of my position on the board, that he would have admitted it, but you alibied me first.

"How about Pater William, do you think he'll make out?"

He chuckled wryly. "The Pater William's we will always have with us as Leslie would say. Yes, I think he'll make out. Not nearly as well as he and his organization had originally expected, but he will build temples and eventually schools and hospitals, and attract neophytes to take up his duties when he goes to his reward."

She said, "Your tone of voice would indicate that you, yourself, don't support any of the United Faiths. In that case, I'd think you'd be against his activities."

Enger shook his head. "I'm not sure about religion, myself. Man's highest religious beliefs have been a yearning toward a perfection that perhaps isn't within man—at least not yet. However, the very fact that he is able to yearn is an indication of his ultimate stature. So far as the Temple is concerned, you don't reform a religion by destroying its priests, ministers, parsons, chaplains, mullahs, gurus, or whatever. Religion is in the minds of the people. If they grow sufficiently sophisticated to reject an organized religion with shortcomings, then they'll reject it. Not before."

"A woman's intuition tells me that you've discovered Pater William's last name."

He was still looking out over the plain. "So you knew, too?"

"Yes. But how does it fit in with your . . . your mission?"

Enger said slowly, still not looking at her. "Pater William did two things when he took his oath as a Temple monk. He dropped his last name and swore celibacy. He'll never have descendants. One day, Cathy, we and our children will attend the funeral of the last of the Peshkopi, who will have died in the fullness of his years."

She snorted deprecation. "I must say, that's the most offhand proposal of marriage I think I've ever heard of." ■

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THE REFERENCE LIBRARY

P. Schuyler Miller

"BIG TIME" PSIONICS

In the last few months psionics—telepathy and a little more—has joined longevity, final wars, and other familiar science-fiction themes and gimmicks as the key element of two "main stream" novels. One falls rather flat, though not for the usual reasons. The other is an outstanding satire which has earned an international reputation.

Margery Allingham is an English writer who has been turning out expertly plotted and professionally written mystery novels almost as long as Agatha Christie. Less prolific than Miss Christie, she has nonetheless held her place in the top rank with her occasional stories about the exploits of Albert Campion. Now, in "The Mind Readers" (William Morrow & Co., New York; 1965; 274 pp.; $4.50), she puts Mr. Campion to work on a complex of mysteries surrounding a secret British research project to develop controlled telepathic communication.

The fuse for the book is evidently the occasional publicity in newspapers and magazines about the serious research into psi now being undertaken by governments and industries throughout the world. Godley's Island is one such research station, and its investigations are rather convincingly described in the early chapters. But the electronic amplifier for telepathy which is the fuse for most of the action, including a few murders, is not developed by the UCAI scientists but discovered accidentally by two schoolboys. Attempts to kidnap them and their "iggy tubes" keep the plot boiling. With brief exceptions, the operation of their discovery is wholly unconvincing, and the action part of the story is not up to the author's own high standards. Mystery and telepathy aren't even in the running, compared with such a story as John Brunner's "The Whole Man" of last year.

"The Makepeace Experiment," by "Abram Tertz" (Pantheon Books, New York; 1965; 192 pp.; $3.95) is something else again. "Tertz" is the pen name of a Russian satirist

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whose books can't be published in his own country. Here he is telling the story of Lenya Tikhomerov—"Lenny Makepeace"—a retiring young bicycle mechanic in a provincial Russian city, who learns from an old book on oriental occultism how to set up a kind of telepathic field enveloping the town of Lyubimov and everyone in it.

Persuading the townsfolk to depose the Party organization that runs them, and to make Lenny a benevolent dictator, is child's play. By an act of will he can convince the town of the success of the limping Soviet food production program: toothpaste becomes a delicacy; mineral water is vodka—and an alcoholic dies of it; the river flows champagne. Nobody is hungry, because Lenny convinces them telepathically that they are well fed. Everyone works vigorously for the welfare of the community, because Lenny makes them think they want to. The true communism of Lyubimov has no need of money, so Lenny papers his office with it. When Moscow sends a force to find out what has happened, Lenny's mental control sends it wandering in illusion. Soviet and American spies join the rest under his spell.

Abram Tertz's satire is as affectionate as it is devastating. By subtle, gentle contrast he probes the sensitive spots in Soviet bureaucracy and the peasant mentality that resists direction by any means less vigorous than Lenny's total mental control. And Lenny's own human failings bring his insulated, microcosmic state to collapse in the end.

Is real peace in the world possible only under complete telepathic control of everyone's thoughts and actions? Is the communist state inherently unable to function successfully without this total brain-washing? Will ordinary people—or extraordinary people, for that matter—ever be able to work harmoniously for the common good, unless they are programmed as rigidly as by a computer? Abram Tertz raises all these questions, and more. Small wonder that his books are banned in a country where such questions are by definition heretical deviationism.

THE WORM RE-TURNS

Edited by James V. McConnell • Prentice-Hall, Inc., Englewood Cliffs, N.J. • 1965 • 182 pp. • $3.95

From all accounts, *The Worm Runner's Digest* is a unique scientific journal. It has been published off and on since 1959 by the Planaria Research Group at the Mental Health Research Institute of the University of Michigan—first to provide an account of work-in-progress for other possible worm runners, and later as an outlet for a free-wheeling collection of commentaries, parodies, "poems of marginal printability," cartoons, plus the original serious papers. This material is contributed by members of the Planaria Group, colleagues,

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other scientists, graduate and undergraduate students, and Damon Knight.

Planaria are primitive worms shaped something like a Spearmint gum trademark and every bit as peculiar as some BEM's I have met in respectable science fiction here in Analog. Because they are very primitive and can also be taught simple tricks, they are beloved by students of the learning process in all its aspects. If you lop a planarian into halves, the head will grow a new tail and the tail a new head—and both will remember the tricks the original worm had been taught. In fact, you can feed an uneducated worm with an educated one, and the boob will become a planarian Ph.D. But that's another story entirely.

Because the contributions have been published by worm-runners, for worm-runners, they are a little less catholic in scope than the selections in that earlier classic, "A Stress Analysis of a Strapless Evening Gown." Nevertheless, you will find here thoughts on such non-planarian or supra-planarian matters as biological warfare(in the verse of the same name by Peter R. Runkel), science writing ("Dr. B. Willder's Zigzaggery Division," by Robert L. Dean), the function of project secretaries ("Einstein's Girl Friday," by Robert Sommer), Socrates and meteorology, pre-frontal lobotomy of Congolese red-eyed thyroidectomized tsetse flies, the detection of cork-popping, Newton's gravitation project, Foodian psychoanalysis, the nature of mathematical proofs, keys as status designates. Damon Knight's contribution is "A Brief Introduction to Logogenetics"—and if you want to know what that is, buy the book or steal it from your bookstore.

SPACE BY THE TALE

By Jerome Bixby • Ballantine Books, N.Y. • No. U-2203 • 1964 • 159 pp. *• 50¢*

Jerome Bixby used to be one of Astounding's regular stable of writers. However, that was a long time ago. None of the eleven stories in this collection appeared here, and five of them are outright fantasies that never could have. Only one of the lot is at all memorable (if unpleasant), but the rest are good entertainment.

To cover the science fiction first, "The Draw" is the somewhat edgy comedy of the no-good youngster with a large chip on his shoulder, who develops a psychokinetic draw that is next thing to instantaneous. "Laboratory" is a monster-sized slapstick ball, in which an Earthling couple, too nosy for their own good, intrude on the planetoid lab of a couple of extraterrestrials and raise hob with the experiments in progress. "One Way Street" is a gimmick story of parallel time-tracks, very slight.

"Small War" is slight, too, but says a good deal more about the survival qualities of men of good

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will. "Angels in the Jets" is a comedy of hallucination on a strange world. And "The Bad Life," the one you won't forget, is a grimly brutal story of the pitiless degradation of a do-gooder in a penal colony.

Four of the five fantasies are light frolics in the *Unknown* vein, and the fifth, "The Young One," would have been equally at home there. A small boy on a remote farm cautiously makes friends with a youngster his own age, whose family are refugees from Hungary —not fugitives from communism, but werewolves. A boyish prank has nearly tragic consequences.

"Magic Typewriter" is a switch on the wish story: whatever is written on it comes true. This is fine—up to a point.

The remaining three stories are theological fantasies of the kind Mark Twain liked to play with. I think he would have been glad to take credit for "Battle of the Bells," in which a passel of country-store practical jokers find that they have stirred up a hot controversy between emissaries of Heaven and Hell. There's a twist at the end that Mark would have guffawed over.

"The Good Dog" is another the Grand Old Iconoclast would have enjoyed. You recall the old legend of the town that wanted a new bridge and promised the Devil the soul of the first living being to cross it, if he'd contract the job. The forfeited soul was a dog's, but he was a good dog, and Hell couldn't put up with him.

Finally, "Trace" is just a gentle glimpse of an afternoon in a part of the New England countryside that's off the turnpikes and macadam. And the old gentleman who lives there in his trim white house —but that's the story.

THE DAY NEW YORK WENT DRY

By Charles Einstein • Gold Medal Books, New York • No. k-1446 • 1964 • 160 pp. •*40¢*

As New York State and New England go into their fourth year of drought, and New York City begins the year with its silting-up reservoirs less than half full, this excellent novel takes on new meaning. Some of the crises it predicts —and I should say extrapolates— may not wait until 1967: they may be happening as you read this, or have happened before you see it.

It is simply the lively, forceful story of the efforts of a Congressman, a news service executive, and a few others to force New York City to cope with the fact that it is running out of water. It's a book that deserves to have had the prestige of a major publisher behind it, and to have had lively discussion in the press and on the radio. It makes clear the pressures that prevent politicians from doing anything practical to alleviate the crisis—and the necessity that they do

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something, and do it soon. This can happen—not only to New York, but to any other large city that is blindly outrunning its water supply.

You will find real people coping with this real crisis. You will also get a quick lesson in how to win at blackjack. But even as New York reaches such a crisis that only an Act of God can save it, you will find no suggestion that New York State will clean up the Hudson River and make it fit to drink in the reaches above salt water. There are some horrors that New Yorkers will not face!

WORLDS WITHOUT END

By Clifford D. Simak • Belmont Books • New York • No. L-92-584 • 1964 • 140 pp. 50¢

The two novelettes and one short story in this collection are ten years old. Simak was good enough then, but he's better nowadays.

"Worlds Without End" is an almost Van Vogtian story of forces operating behind the scenes of an intricately structured society. The Welfare State guarantees perpetual, tailored dreams to anyone who wants them as a retreat from reality. And then an official of the Dreams Guild discovers evidence that the dreams are not as prescribed or selected, that they are somehow being forged. Who is doing what, and why, make a tricky plot.

"The Spaceman's Van Gogh" is a rather sentimental one about the would-be interpreter of a misunderstood artist, who tracks him to his deathworld.

"Full Cycle" is my favorite, and one of Simak's best. It is a story that Robert Heinlein might have expanded into a novel—an unforgettable picture of migrant tribes, withering communities, pick-up industrialism, education gone useless. This one is a wowser, and I don't know why it didn't lead off a hardback Simak long ago.

Reprints

EXILES OF TIME

By Nelson Bond • Paperback Library, New York • No. 52-804 • 1965 • 159 pp. • 50¢

Vintage of 1948: a time-travel action yarn from 'way back.

EXPEDITION TO EARTH

By Arthur C. Clarke • Ballantine Books, New York • No. U2112 • 1965 • 167 pp. • 50¢

Third printing of one of Clarke's best short story collections.

DRAGON'S ISLAND

By Jack Williamson • Tower Books, New York • No. 43-531 • 1965 • 222 pp. • 60¢

Late and good Williamson, ranging from New York to New Guinea. If my memory serves, it was a Simon & Schuster original.

CONQUEST OF EARTH

By Manly Banister • Airmont Publishing Co., New York • No. SF7 • 1965 • 128 pp. • 40¢

Paperback reprint of one of the minor Avalon titles.

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Dear Mr. Campbell:

As a reader of your fine magazine for more years than I care to remember, and one interested in your pertinent editorials, may I presume upon you for a comment regarding the hush treatment given a rare natural (?) phenomenon?

In June of 1950 a large portion of this country as well as several other parts of the world experienced a "darkness in the daytime" or Black Pall. As you no doubt recall, it started on a Sunday afternoon and necessitated the use of artificial illumination such as necessary at night. The radio and newspapers stated the cause to be a forest fire in Canada, the smoke being trapped in some air layer which caused the widespread dispersion.

I was one of the handful of dubious, who did not believe such a preposterous tale. The more so, when papers the next day did not have pictures nor stories regarding the fantastic fire. A reporter, no doubt, questioned some scientist who said a fire was the probable cause and the wire services picked it up as factual rather than theory.

Several years ago I endeavored to find out what really caused the "Darkness." A check among an old collection of history books netted one book with factual data of previous occurrences, the last one occurring in 1871, the same year as the Chicago fire, but having no connection with it. In the history of this country there have been several such events back to the seventeenth century. All scientific minds of the day were puzzled; no explanation was ever given. (Unlike the complacent scientists today, investigations were made).

It was suggested to me that I contact the Canadian Information Service in New York City with regard to possible fires during the time of the "Darkness." I wrote to them and after about six months received a reply. They told me that my question had caused them considerable trouble. The Canadian Forestry Service checked through records

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and found that there were *no fires* of any consequence during the Darkness. They also found that the Darkness extended as far as Scotland. The sum total was that the cause could not be determined.

There was enough information in the history source for an article on the subject. Scientists on previous occasions made a thorough investigation so far as facilities permitted and did discover some unusual items too numerous to go into here.

Something came between the Earth and the Sun on several occasions that has caused about one fourth of the Earth's surface to be in darkness. Now for some questions.

Why was no investigation made in this country? What reports, if any, came from high-flying planes during this darkness? Was any attempt by anyone made to use radar to determine if a sizable mass caused the Darkness? Did any country make any investigation? An atomic explosion can be ruled out; they didn't have atomics three hundred years ago. How about an article in a forthcoming issue on this subject? Thank you.

WITMER ZELL
1322 Fourth Avenue
Ford City, Pennsylvania

It's perfectly all right to ask questions when we know the answers. But questions like this are impertinent, silly—and very disturbing. Go away and don't bother us; we're busy!

Dear Mr. Campbell:

I live near Appalachia and have seen the TV antennas you speak of. However, in your editorial you left out another devastating point: the relief is forty-five dollars a week, while jobs for waiters, waitresses, et cetera, go begging at forty dollars a week!

Thank you very much for a little sanity in this socio-liberal world.

Philip Logan
School of Pharmacy,
University of North Carolina

And remember—you can't collect relief it you work for money.

Dear John:

Re your editorial "The Mobsters": In it you suggested that one way to break up a mob without producing "martyrs" would be to subject said mob to a dense white fog and to sound-control techniques.

Well it appears that someone with enough authority to Get Things Done read your editorial carefully, for in this week's *Life* there is a photo of a new M.D.D. (Mob-Dispersion Device). This device produces the same effect as a fog generator by spewing forty thousand gallons a minute of opaque, sound-stopping and completely harmless detergent foam.

Actually, this M.D.D. has marvelous possibilities. You could tie it in with the "keep your city clean" campaign. The mobsters couldn't claim you were using dirty tactics. If you used a diaper-cleaning deter-

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gent, you could tell the world, "We're giving 'em the Cry-baby Treatment," and feed the press a lot of soft soap about having the cleanest demonstrations in the state. The mobsters' hopes will go down the drain as their demonstrations turn into complete washouts and as you start a clean-up campaign, mopping up the crowds and making the newly-captured mob leaders *really* come clean!

RICHARD BOOTHE
1134 Kagawa
Pacific Palisades, California 90272

And many times the demonstrators are complaining about how dirty their section of the city is, so the device is simply giving them what they asked for.

Dear Mr. Campbell:

I have just finished reading the letter in Analog for July of this year by Mr. Craig Anderson of San Jose, California, and your comments on it. The situation in Berkeley is enormously complicated and I do not believe that either you or Mr. Anderson have even touched upon what is, perhaps, the most important aspect of it.

I was in Berkeley most of last summer with my son, a regularly enrolled student at Reed College in Portland, Oregon, who was taking some special work at Cal. The demonstrations had not yet started, but the student morale was at a fairly low ebb. A few weeks ago I attended a panel discussion here in Houston about how much freedom—in terms of electioneering, et cetera—should be permitted on university campuses. The moderator was the Dean of the Law School of the University of Houston and other members were a professor of biology from the University of Texas at Austin, the Dean of Student Affairs of Southern Methodist University at Dallas, an undergraduate student of Rice University here in Houston, and a prominent Houston attorney and former Regent of the University of Texas. As you might suspect a wide liberal-conservative spectrum was represented on this panel.

Widely differing points of view were energetically expressed but there seemed to be a general consensus that many great universities are run—or not run—by faceless bureaucracies, and the administrators are usually away on a trip, or are otherwise inaccessible, when the students want a straight answer to a problem. The thing that precipitated the big trouble on the Berkeley campus was that Dr. Kerr, the president, was out of the city when a serious problem arose, and his stand-in was incompetent or unable, or unwilling to meet the problem, and his actions only served to antagonize the students.

It is also often difficult for the students to gain audiences with senior professors. They, like the administrators, seem to be out of town most of the time getting grants for research projects and the routine

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teaching is frequently left to graduate students. I, myself, have been connected with large university systems in one capacity or other for the past twenty-three years or so, and I know these things to be true. The point is that these kids—and/or their parents—often make very considerable financial sacrifices to be able to go to a great university and when they are confronted with situations like this they soon become disheartened and disillusioned. The next reaction is anger and this is where the "far out" groups such as you and Mr. Anderson were talking about come in. In this context I might say that the role of Mario Savio, the philosophy major who was supposed to have masterminded the entire revolt has been greatly exaggerated. For every "beatnik" there were many, many serious-minded well-intentioned boys and girls who were deeply concerned.

HEINRICH NEIDHARDT, M.D.
2305 Sunset Blvd.,
Houston 5, Texas

Moral: Small and medium-sized universities or colleges can do better by the individual student. This is news?

Dear Mr. Campbell:

In "The Adventure of the Extra-terrestrial" Mr. Reynolds seems to have neglected a fact of some importance. Though the name is never mentioned it is clear that the story is about Sherlock Holmes, who, in several stories such as "The Adventure of the Three Garridebs," showed a great affection for Dr. Watson. Surely Holmes would, therefore, have taken Watson with him when he left with Senor Mercado-Mendez.

WILLIAM J. WESTBROOKE
4525 Lincoln Way
San Francisco, Calif. 94122

Ahh—but would the Senor?

Dear Mr. Campbell:

I would like to call to your attention a statement that you made in your editorial in the July 1965 Analog: "That American workmen *want* unions, that take care of their problems, even when those unions are run by crooks who gouge them and steal half the union funds." Really, John! Contrary to what most of your readers probably think, you should re-evaluate the position you apparently take in that statement.

First, let's find out what is meant by "union." My dictionary gives a good definition of the word ". . . an agreeing or leaguing together for mutual benefit." A union is not a separate entity apart from the workmen, craftsmen, or doctor (the A.M.A. is a union). A union is made up of, and I might add, run by its members.

I will agree with your first idea in that statement; most workmen do want unions!

Your second idea seems to say something like this: workmen want unions to take care of their problems, so that they—the workmen—

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won't have to. This couldn't be farther from the truth. Most workmen, especially those in large companies, have found that they can't bargain with them in good faith; in fact, most employers don't want to bargain with the workmen on a group basis. The usual solution to this problem is that the workmen on a group basis—a union—force the employer by the threat of a strike to bargain with them, and to make a legal contract covering the agreements made in the bargaining. Unfortunately, the membership of the union must then "police" that contract, because there are few if any companies that even try to uphold the contract that they have agreed to. No, John! The workmen don't want a union to take care of them, they are forced to form a union so that they may solve their own problems with their employer.

Your third idea about crooks is self-explanatory, but it doesn't seem to make much sense. A union is made up of its members and these members use a democratic system to have someone represent them, not to have anarchy. These representatives are elected and ultimately controlled by the membership. Most people don't elect and maintain someone in office to ". . . gouge them and steal half the union funds." I must admit that there probably are some crooks in union offices, but I would bet that if the membership knows and believes that someone in office is that much of a crook, he won't be in office very long. I would also bet that there are even more crooks in company management who can't be voted out of office.

MICHAEL D. BROOKS
182 So. Westchester Drive,
Anaheim, California 92804

1. A group-entity, such as a nation, a union, or the W.C.T.U. for that matter is like a vortex in water or air. It's made up of molecules-in-motion; the dynamics of the system, not the units in that dynamic system, constitute the vortex—or the union—and control the behavior of the units in a major degree.

2. It is perfectly normal for each side of a disagreement to feel that the other side is not being fair and honest in the discussion. Any company executive can tell you, with deep sincerity, of the intransigence, arrogance, and fanatic uncooperative behavior of Union representatives. So? So that's why Union-Management disputes should be settled by binding arbitration conducted by members representing the general public interest.

3. The Nazi regime in Germany was a Democratic system. Just ask any Nazi. China is a People's Republic, with Democratic principles. Ask any Chinese Red. How come Jimmy Hoffa remains in Union office despite repeated trials and convictions?

4. How come many Unions have "goon squads" to keep the happy members together?

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about five times as strong as the ultimate theoretical maximum of iron, is beryllium—which is the lightest metal that doesn't react spontaneously with air and water. (Lithium's lighter, as are sodium and potassium, but not very useful structurally!) Beryllium, however, is one of the "forbidden" elements lying between helium and carbon—elements that can't exist in the active heart of a star, since they're extremely reactive thermonuclear materials. Nucleogenesists haven't yet figured out how the darned things are created, and they're definitely rare elements, although widespread on Earth. Beryllium's the rarest of the three, lithium, beryllium and boron.

But we needn't pin our hopes on better beryllium supplies; it took only a little further investigation to show that the substances classified generally as "ceramics" were far and away stronger than any metal! The reason aluminum oxide, silicon carbide, diamond, and even silica are used as abrasive materials is that these crystals have such enormously strong internal bonds that any metal crystal cuts like cheese. The hardest steels wear down very rapidly indeed when forced to grind against even relatively soft rocks. Talc, so soft it cuts easily with a fingernail, can take the edge off a steel sawblade in a shocking hurry. Talc crystals can slide very easily across each other—but the crystals themselves are hard. Graphite, commonly used as a lubricant, is composed of crystals immensely harder than steel.

The ceramic or stony materials are actually far stronger than the strongest metals.

Some years back I did a story in which there were some aliens who had bones made of iron, instead of stone; at the time it seemed like a great idea for super-strength men. Biologically, it's perfectly possible for organisms to produce metallic iron—or a chrome-nickel-manganese steel, for that matter. What I didn't then realize is that iron is *not* as strong as stone—when the stony material is held in a strong second-phase material such as collagen protein glue!

Bone is a two-phase structural material, using calcium phosphate crystals glued together with collagen. A billion years ago, animal organisms on Earth worked out the two-phase system, and started using either silica or calcium carbonate plus collagen as a glue. Evidently, calcium phosphate makes a stronger two-phase material; phosphorus is precious to living organisms, and wouldn't be squandered on bones if either silica or calcium carbonate, both far more available materials, would do as well.

At any rate, the structural material is stronger than steel—and is, moreover, placed in enormously

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sophisticated formations, laid down by microscopic workmen called living cells, who can place the extremely high-strength material in the best possible forms for the optimum distribution of the stresses. No solid masses where they are unneeded—no lack of dense material where the stresses are high.

And the net result is a structural member that industrial processes we know can't begin to match, either for strength of material, nor for stress-analysis distribution of strength.

Naturally, that poor little robot's arms and legs came off when it came into conflict with a machine of such far higher engineering design! Human technology has had only a century or so of real engineering study; animal organisms have been field-testing and developing more compact, more powerful and more effective units for two billion years.

Again, let's consider how the robot's hands were powered. Yours are operated by a very large number of separate, separately operable chemical-fueled motors. They are not only separately operable, but are made up of enormous numbers of microscopic individual units, any one, or all of which can be thrown into operation. It's very rarely that all are thrown into action; that's an all-out-desperate-last-ditch emergency order. So powerful are those muscle-motors that, despite the fact that bone is stronger than steel, when all muscle-fibers pull together, the bones frequently snap under their enormous stress. The normal operation calls for a fraction of the fibers in any one muscle to pull, and things are so arranged that which individual fibers are pulling shifts randomly, so that at all times some of the fibers are pulling, while others are resting. They're highly efficient motors, too; their fuel efficiency in converting chemical energy to mechanical work exceeds that of the best Diesel engines, and matches, or exceeds, that of the best major steam-power stations. Gasoline engines aren't in the same league.

That poor little robot had to get along with electric motors or solenoids—a pretty poor compromise. Think of all the individual motions the five fingers of your right hand are capable of—and try packing separate electric motors-with-gearing into the forearm of that robot to operate all those motions! You couldn't get that much equipment in the body cavity, let alone in the forearm.

Sure—I know that Science Will Progress. But you can't talk about that, because you can't guess in what directions it will jump; if we talk about what we now know, our technology couldn't produce anything vaguely approximating a robot that could match, or even come vaguely close, to the human machine. We can say, with equal wild-

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guessing-into-the-future, "Well, the way those robots work is that they use a total-annihilation of matter reaction for power, their weight and mass don't matter because they have gravity and inertia neutralization, and they apply force by using mechanically-generated telekinesis fields."

O.K.—so I defeat them by using my teleportation to throw them into the Sun.

If pulled-out-of-the-hat stuff is allowed, I can pull stuff out of my hat, too.

What we're discussing is, in essence, the crystalloid machine vs. the colloid, or biological, machine —and I contend that the colloid machine is intrinsically a better approach.

There's been talk about the cyborg—the half-man-half-machine —man of the future, a super-man because of his machinery. Basically, recognize that a living organism is a machine, too; it's a colloid machine instead of a crystalloid machine, but in all other respects, it's a machine. Instead of flecks of silicon and germanium crystal, it has complex colloid structures with remarkably similar functions—and, moreover, units that have to be magnified one hundred times or more before they become as gross as the microminiaturized circuit elements of the crystalloid machines!

The cyborg, instead of being a super-man, would quite literally, be a half-man—something better than a modern quadriplegic, perhaps, but far, far less than a normal human being.

The idea of replacing human parts with machine equivalents is, in large degree, based on the assumption that crystalloid components are, by their nature, more reliable and stronger and more enduring than the sloppy gelatinous material of a colloid machine. We've already considered the matter of relative strength of crystalloid and colloid structural members; let's take up the matter of reliability.

First, let's consider how wonderful it would be to have that fallible human muscle-engine, the heart, replaced by a powerful, reliable machine—a crystalloid pump that you could *rely* on.

Hm-m-m . . . can you name a machine—one more complex than the electroscope radium clock, that is—that you'd bet your life on for seventy years of absolutely unfailing operation, with no external service or repair? The JPL people were delighted that Mariner IV sent back pictures from Mars—it had been computed that there was only a seventeen per cent probability that all that equipment would remain functional during the eight months it took to get out to Mars—and that doesn't mean eight months of *operation*, but eight months of simply standing by waiting.

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Now a cyborg heart would be approximately equally complex—it's got to have not only the mechanical function of blood-pumping, but also a very complex rate-control mechanism to adjust blood volume to various conditions of rest, sleep, walking, running, fever, high altitude, and all the various conditions the heart adjusts for.

It's also worth remembering that, because the heart is tied in with the general nervous system, it will start increasing its pumping rate *before* the emergency actually arrives—it has a "negative reaction time" that can be of immense advantage when emergencies do come up.

Moreover, if a man gets into one of those emergency spots like being stuck in a lifeboat at sea, he doesn't have the additional worry of when will his heart-battery run down.

The heart machines will, certainly, be vastly improved beyond any yet made—but the ones I've seen so far wouldn't fit conveniently in Uncle Silas' sea chest, let alone my chest.

But for reliability, everyone knows that crystalloid machines are vastly superior to colloids, don't they? Of course, colloid machines are capable of internal self-repair, self-maintenance and adaptation to accidents, which is very handy when a valve doesn't function quite as it should, due to some other malfunction.

My personal preference would be that the biologists get on the stick and do some more work on tissue culturing. What I want, if my heart—or any other organ—gets in trouble, after a half, or three-quarters of a century of uninterrupted self-maintenance and repair, is to have it replaced by a new one of the same superb design. No crystalloid gimcrackery, thanks—they don't make pumps that good!

And I don't mean replace my present one with a heart taken from someone else; to do that, you'd have to knock out my immune-reaction mechanisms, so I couldn't react to fight disease. I mean another heart *of my own tissues*. It's perfectly possible to grow tissues in culture media; a beginning on that has already been achieved. Why take a heart—or any other organ—from someone else, which will necessarily conflict with my unique individual biochemistry, when *my own cells* can be cultured to produce a new one which will not call forth immune response?

Colloid machines, because they are capable of internal self-repair, self-maintenance, and self-adaptation—plus automatic reproduction! —are, in the real sense of enduring operation under bad conditions, incomparably superior to any crystalloid machine yet built—or buildable in the foreseeable future. They, not crystalloid machines, are the reliable ones.

There's a lot of feeling that col-

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loid machines are unreliable in performance, where crystalloids are infallible.

Part of that stems from the definition of "reliable." By "reliable" we ordinarily mean "predictable" —i.e., that we can extrapolate from the machine's past behavior, precisely what it will do in the future.

This type of behavior is characteristic of the most abysmally stupid forms of life—and of our most advanced computers. Such primitive entities behave in a purely logical manner, and have no intelligence, and no ability to learn.

Cyberneticists are now aware that for intelligence, an entity must be capable of inconsistent—i.e., nonlogical—behavior. It must be capable of performance that is more than a simple extrapolation of its past behavior, but the result not only of learning-from-experience, but of reaction to abstraction-from-experience. If Isaac Newton, after being hit on the head by an apple, had learned to stay out from under apple trees, that would have been learning-from-experience. But to leap from apple trees and falling apples to the concept of the Moon obeying the same basic force—that was a logical inconsistency, an intuitive leap. No logician could have extrapolated from previous observations of Sir Isaac's behavior that he would react with that totally new postulate, instead of being logical and getting out from under the apple tree.

An intelligent machine would, therefore, be as "unreliable" as any other kind of intelligent entity. It would be unpredictable-by-logical-methods.

That small colloidal machine known as an ant is not intelligent; it is simply an exceedingly complex organic computer system; an entomologist can predict how an ant will react with about as high reliability as a cyberneticist can predict how one of his cybernetic devices is going to perform.

As soon as the cybernetics boys come up with an intelligent computer—it'll be "unreliable."

Put it this way; if we wanted to get information on the constitution of Jupiter's deeper atmosphere, we might build a Mariner XXVI or so, programmed to dive down below the outer fringes, and send back data on the deep layers, far below the level of optical penetration. So a far more highly evolved Mariner is sent out, programmed to dive into Jove's immense atmosphere. But—it suddenly radios back from Jupiter: "Have gone into orbit around Jupiter at three hundred thousand miles. Decided Jupiter unsafe for me; will stay out here where it's safer." This would constitute unreliable behavior, so far as JPL and NASA were concerned—but it would certainly be more "intelligent" than the Rangers that suicided dutifully on the Moon.

Crystalloid machines are *not* in-

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herently more reliable; they're simply exceedingly stupid, so far. They aren't inherently stronger; to date, in terms of pound-for-pound and cubic-inch-for-cubic-inch, colloid machines have them far outclassed.

But the crystalloid machine does have inherent characteristics that the colloid can never match. If what you want is a stupid, reliable device that can reach down into a steel-mill soaking pit and lift out a yellow-hot ingot weighing a dozen tons, plonk it neatly onto the bed of a rolling mill, and squeeze it down to neat I beams—that's a job for a crystalloid machine. Colloids can't operate at incandescent temperatures.

They can't operate at liquid helium temperatures, either.

They can't grow to the size necessary to lift 250-ton locomotives around, by reason of the very fact that makes them self-repairing. They metabolize throughout their bulk—and that means heat-generation throughout that bulk. When they get that big, there is no such thing as "cold-blooded"; fermentative processes alone would generate so much heat, with so small a radiating surface, that they'd cook themselves in their own juices—literally.

On the other hand, there are jobs that crystalloid automation might do all right—but never will.

Some years back, the Army was looking for a vehicle for use in Arctic territory; they wanted something that could operate over the wild variety of Arctic terrain in all seasons. Muskeg swamp—open rivers, with steep, slippery banks—on thin, broken ice in fall and spring—climb over pack-ice in winter—work effectively from −90°F to +95°F., through shallow streams with sand and gravel, or over barren rock.

What they really need, obviously, is a pack of trained Polar Bears. Those colloid machines can, moreover, live off the country, and are self-repairing, self-maintaining and self-replacing.

Hovercraft? Heh! Like to see you control one of those contraptions when an Arctic blizzard gets howling! They are as willing to go sidewise as forward. Or hold it on a 45° slope for a traverse. And they won't operate on walrus blubber and frozen fish, either.

Those automated automobiles they've been talking about, with electronic computer control that can follow a complex network of signal cables built into the roads? Just dial your destination, and the thing follows the cables and gets you there.

Provided, that is, all the cables are all functioning properly, as is every component in your computer-gadget *and in the computers in all the other cars around!* Because, of course, your computer will inevitably, in its one-track, super-stupid little mind, do what it's supposed to, even if some other car is roaring.

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along the wrong way on the highway.

Sure, it'd be convenient to have a car that would take you safely home after a pleasant but alcoholic celebration somewhere. But heck—Grandpaw had that problem licked. What we need is less horsepower and more horse sense installed in our cars. Organic computers are a darned sight cheaper!

The greatest food supply this planet produces is naturally enough produced on the greatest area of the planet—the sea. Plankton represents several orders of magnitude more food than our arable land produces. Very reliable, too; it never suffers from drought or floods.

What we need is a machine that can harvest that crop, gather it, process it, and convert it into satisfactory human food. This requires a large, mobile, self-propelled vessel, capable of navigating over huge stretches of open sea—avoiding rocks and sandbars—able to hold the sea in all weather while gathering and processing the plankton.

Crystalloid machines could be built no doubt; it'd take quite a few megabucks worth of computer equipment to run it, and maintenance and repair of such equipment would be distinctly expensive.

There's an excellent machine for this service already in use by the Japanese. It's called "a whale," and supplies good-quality steaks in fifty to seventy-five ton lots. A little biological engineering could perhaps improve the colloid machine slightly—but economically, it's got the crystalloid competitors beat right now!

It's been shown, by the psychology department at Harvard, that trained pigeons make ideal assembly-line small-parts inspectors. They've evolved, over several megayears, as natural-hatched small-parts inspectors, able to differentiate between sand, gravel, seed hulls and good seeds. They can recognize seeds and not-seeds in any orientation, in any kind of light, however rotated—a feat that requires an immensely complex and highly sophisticated computer. A new pigeon, ready for training, costs about seventy-five cents; a new computer, ready for programming, costs about three megabucks.

So why do, with crystalloid machines, what a colloid machine can do so much more cheaply?

Reliability? Hah! Wait till you've got a computer with sufficient discrimination and evaluation circuits to be able to do it at all! Betcha, when you have it, it turns out to make intelligent decisions like, "I wonder what happens if I reject *all* the units as defective?" Or "If I stop rejecting the defectives, maybe they'll give me something different and less boring to do."

When you make a computer with that level of ability—are you *sure* it'll be stupid enough to be reliable?

The Editor.

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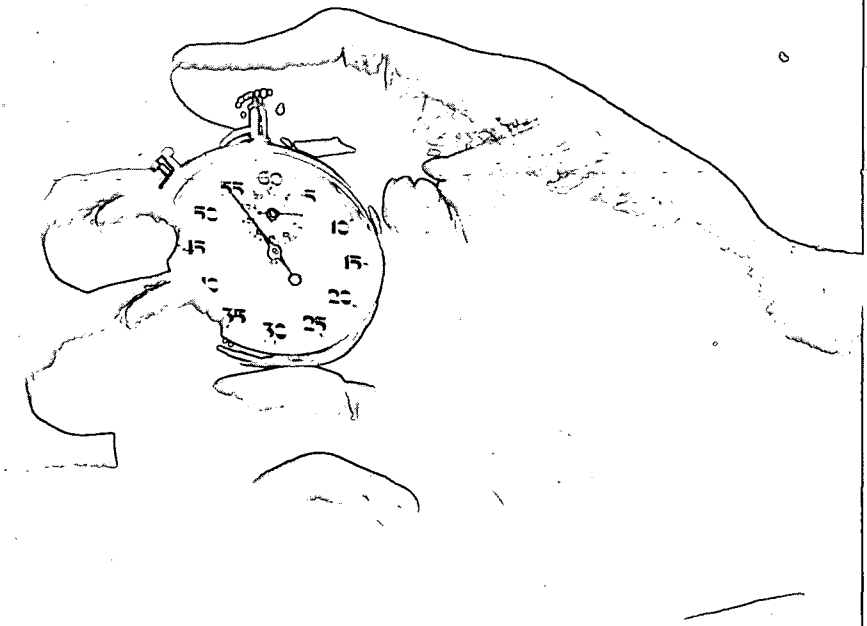

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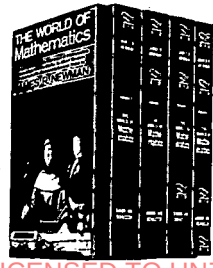

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